TRANSACTIONS AND PROCEEDINGS

OF THE

ROYAL SOCIETY OF SOUTH AUSTRALIA

(INCORPORATED).

VOL. XLVIII.

[WITH PORTRAIT, THIRTY-ONE PLATES, AND SIXTY-SIX FIGURES IN THE TEXT.]

EDITED BY PROFESSOR WALTER HOWCHIN, F.G.S.,

ASSISTED BY ALBERT H. ELSTON, F.E.S.

PRICE, TWENTY SHILLINGS

Adelaide:
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(INCORPORATED).

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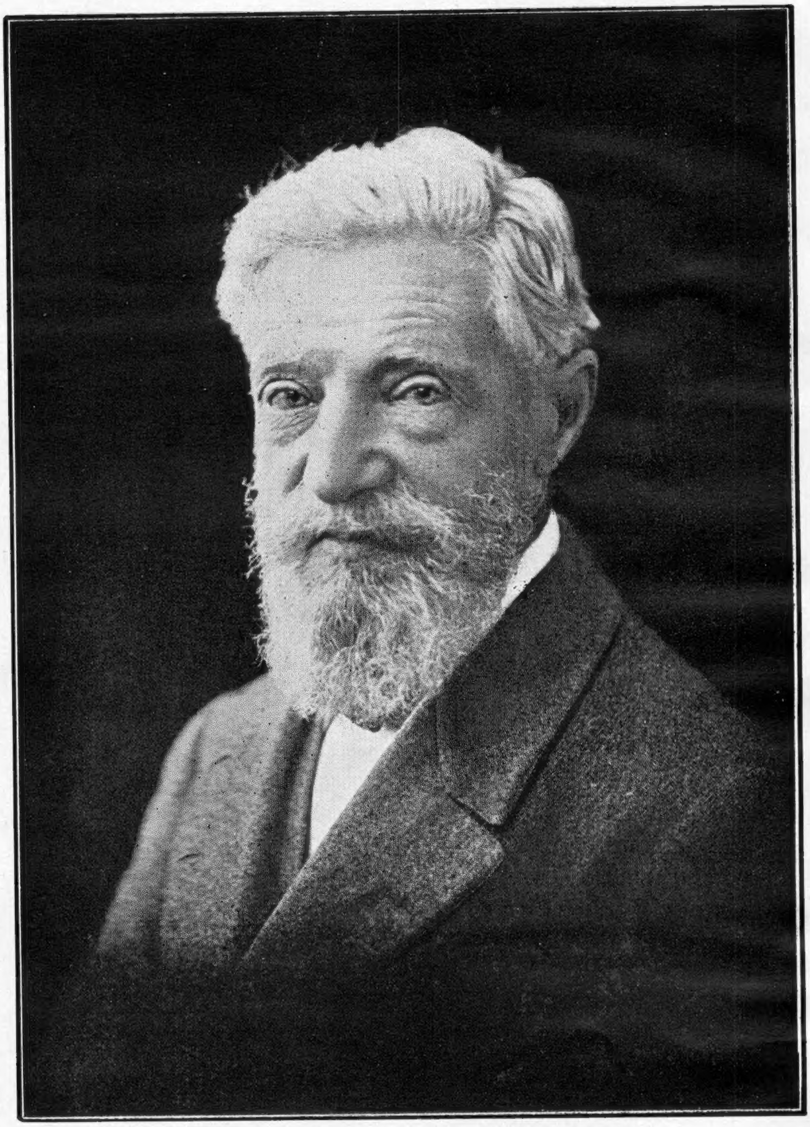

THE LATE WALTER RUTT, C.E.

Transactions
of
The Royal Society of South Australia (Incorporated)

VOL. XLVIII.

OBITUARY NOTICE (WITH PORTRAIT).

WALTER RUTT, 1842-1924.

With deep regret we have to record the passing of the Senior Fellow of this Society, Walter Rutt, on the 17th May, at his home in College Park.

It is comforting to have the assurance of his friends that he did not suffer, but maintained his usual health and interests practically up to the time of his death.

Only two days previously he visited the Society's rooms, and after performing various duties connected with his office, inserted his photograph in the Society's album. He was well on Saturday morning, but developed what appeared to be a slight cold during the day. This did not, however, cause him to retire before his usual hour at 9.30. At 11 o'clock he was dead.

His death will be regarded as the removal of a familiar landmark, which has witnessed the growth, the expansion and vicissitudes of fortune, of this Society during the last 55 years.

Though his life appears to have been singularly devoid of striking incident and deep contrasts, such as fall to the lot of some men, it was nevertheless a life of good and useful purpose and quiet achievement.

He was born in London, where he was educated at University College School, and subsequently trained as a Civil Engineer. He migrated to this State when he was 27, and immediately entered the Engineer-in-Chief's Department, where he remained until he reached the retiring age twelve years ago. He was in no sense a rover.

In 1869, soon after his arrival, he became a member of the old Adelaide Philosophical Society during the days of its greatest stress and adversity, at a time when it was necessary to realize on its books and movable property in order to meet its financial obligations.

At various times, as Hon. Secretary or Hon. Treasurer, he held office for a cumulative period of forty years, during which he gave the most devoted and meticulous service to the affairs of the Society.

In 1880, as Hon. Secretary, he was one of the signatories to the memorial which petitioned for the Royal permission to change the title of the old Society to that of "The Royal Society of South Australia."

Mr. Rutt never became President, but occupied the Vice-Presidency from 1909-1911.

During his long membership he only contributed two papers to the Transactions, one on "The Flight of Birds considered in connection with Aerostatics," and the other "Notes on a Boring at Port Wakefield."

The photograph in the Society's album, and which appears as the Frontispiece to the present volume, was taken in 1917.

R. S. Rogers.

June 12, 1924.

NOTES ON AUSTRALIAN CRUSTACEA.

No. II.[1]

By HERBERT M. HALE.
(Contribution from the South Australian Museum.)

[Read April 10, 1924.]

PLATES I. AND II.

Family GNATHIIDAE.

Two species of these remarkable Isopods have been hitherto noted from Australian waters, but no member of the suborder has been previously recorded from the southern coast.

The characteristic pseudo-mandibles of the male are doubtless utilized to grasp the female during copulation. In describing a sponge-dwelling species from South Africa, Barnard writes: "The male was found either sitting in the mouth of the burrow with the mandibles just projecting or clasping the female."[2]

In each of the species listed below, the male is known from only one specimen. Undoubtedly a great number of small forms of Crustacea inhabiting the waters of South Australia remain to be collected.

GNATHIA, Leach.

Gnathia, Leach, Edinb. Encycl., vii., 1814, p. 402; Barnard, Ann. South Afr. Mus., x., 1914, p. 201, and xvii., 1920, p. 332 (syn.).

Anceus, Hesse, Comptes rendus, 1855, and Ann. Sci. Nat. (4), ix., p. 93.

Ancaeus, Hesse, Ann. Sci. Nat. (5), xix., 1874, p. 8.

KEY TO MALES OF AUSTRALIAN SPECIES.

a. Medial length of head three-fourths, or more than three-fourths, the greatest width. Third and fourth thoracic segments separated by a marked constriction.

- *b.* Dorsum of head almost covered with small, rounded, uniform tubercles; not areolate; not deeply excavate anteriorly. Fifth and sixth thoracic segments medianly divided dorsally. Length, 2·5 mm. .. .. *latidens*
- *bb.* Dorsum of head with large and small tubercles on anterior third only; remainder with large and distinct areoles; deeply and broadly excavate anteriorly. Fifth and sixth thoracic segments not split. Length, 4·1 mm. .. .. *mulieraria*

aa. Medial length of head less than three-fourths the greatest width. Third and fourth thoracic segments not separated by a constriction.

- *c.* Anterior margin of head deeply incised, with a median tooth which does not reach to the level of the antero-lateral angles of head. Eyes small. Mandibles large, longer than head. Fifth and sixth thoracic segments not split dorsally .. .. *ferox*
- *cc.* Anterior margin of head produced, the middle reaching beyond level of antero-lateral angles of head. Eyes moderately large. Mandibles small, about one-half length of head. Fifth and sixth thoracic segments medianly divided dorsally .. .. *pustulosa*

The characters given for *G. ferox* are taken from Haswell's description and figure.

(1) No. I. appeared in Rec. S. Austr. Mus., 1924.

(2) Barnard, Ann. South Afr. Mus., xvii., 1920, p. 334.

GNATHIA FEROX, Haswell.

Anceus ferox, Hasw., Proc. Linn. Soc. N.S. Wales, ix., 1885, p. 1005, pl. lii., figs. 1-5.

Hab.—New South Wales: Port Jackson.

GNATHIA LATIDENS, Beddard.

Anceus latidens, Beddard, Proc. Zool. Soc., 1886, p. 120, and Rep. Sci. Res. "Challenger" (Zool.), xvii., 1886, p. 141, pl. xviii., fig. 11.

Hab.—Northern Australia, Flinders Passage, 7 fms.

Gnathia mulieraria, n. sp.

Pl. i., figs. 1-8; pl. ii., figs. 1-3.

♂. *Head* large, subquadrate in outline, the medial length more than three-fourths the width; dorsum anteriorly forwardly inclined and broadly excavated, the depression deepest and widest in front; at base of head is a small furrow on each side of the median line; at the bottom of the large excavation is a large, elongate-oval tubercle, almost one-third the length of the head and arising near the anterior margin of the head; on each side of the central tubercle is a large, obtusely-conical tubercle, behind which, and nearer the eye, is another similar but smaller projection; to the rear of the latter is an oblique row of three tiny tubercles; posterior three-fourths of dorsal surface with eight large areoles; on the interspace alongside the outermost of these is a longitudinal row of tiny spinules; anterior margin of head sinuate, prominently tridentately produced between mandibles; antero-lateral angles crowned with a forwardly-directed, unevenly-quadrate tubercle, which overhangs the base of the antennae. Eyes small, their longitudinal diameter one-fourth the length of the head. Antennae long, the first pair extending to the second-third of the fourth joint of the second pair. First joint of superior antennal peduncle longer than second joint; third much longer, two and one-half times as long as second; flagellum five-jointed, second and third joints longest, subequal in length. Third joint of peduncle of inferior antennae as long as first and second together; fourth nearly half as long again as third; flagellum seven-jointed. Mandibles large and prominent, a little shorter than head, scoop-shaped on inner surface; intero-inferior edge crenulate and superior edge incrassate, notched at the first fourth of the length; distal portion bent upwards and inwards.

Thorax.—Second to sixth segments with more or less distinct small areoles. First short, almost as wide as head, strongly constricted on each side; closely coalesced with head, the suture rather indistinct. Second medianly as long as first, the antero-lateral portions curved forwards, but not quite reaching head; lateral edges twice as long as medial length; posterior margin slightly sinuate. Third as long as first and second together. Fourth separated from third by a marked constriction; nearly one-third longer than third; tumid on each side, the swellings almost meeting medianly. Fifth slightly longer medianly than fourth; lateral margins longer owing to concave posterior margin; slightly swollen towards sides. Sixth twice as long as third, the lateral portions swollen, produced backwards postero-laterally; sides sinuate. Segments one, two, three, and five are subequal in width; segments four and six are narrower; segment seven small and inconspicuous, little more than one-third the width of the sixth and not as wide as the abdomen.

Abdomen moderately large, more than one-fourth of the total length exclusive of the mandibles. Epimera prominent. Sixth (telsonic) segment as long as wide, the margins sinuate; posterior portion with a strong hair on each side; apex subacute with two setae. Uropoda elongate, subtruncate

apically; inner branch (not counting marginal setae) extending to level of termination of abdomen, as long as, but wider than outer branch; terminal setae as long as uropods and their peduncle together.

Peraeopods.—First pair operculiform, two-jointed; basal joint large with three distinct areoles; fringe of hairs on inner edge rather stout, spaced; second joint one-fifth as long as first, subcircular, with several setae at apex. Second to sixth pairs moderately strong, armed with a few spines and some long hairs.

Pleopods short, with long apical setae; about one-fifth as long as abdomen.

Colour (during life).—Antennae, legs, mandibles, and tubercles of head white. Aeroles of dorsum of head and thorax yellow; interspaces pale brown, closely dotted with brown chromatophores, which become larger and more diffused on the posterior two-thirds of thorax. First to fifth abdominal segments pale yellow, with a few chromatophores at sides; telsonic segment, uropods and pleopods subhyaline.

Length (excluding mandibles), 4·1 mm.; width of head, 1·1 mm.; greatest width of thorax, 1·05 mm.; length of abdomen, 1·05 mm.

Praniza Larva.—*Head* small, subtriangular, with the mouth parts projecting. Eyes large, occupying nearly the whole of the lateral margin. First antennae as long as peduncle of second pair. Flagellum of superior antennae four-jointed, the second joint much the longest. Fourth joint of peduncle of inferior pair twice as long as third joint; flagellum seven-jointed.

Thorax.—First segment short, narrow, inconspicuous. Second wider than head, a little curved forwards. Third longer and wider than second. Fourth, fifth, and sixth more or less swollen, the posterior sutures of fourth and fifth indiscernible. Seventh small, narrower than abdomen.

Abdomen.—Much as in adult male.

Peraeopods.—The six pairs of subprehensile legs are relatively much more slender than in the male.

Colour.—Head pale testaceous, with a few crowded black spots. Thorax milk-white, with a few scattered, hieroglyphic-like black chromatophores. First to fifth segments of abdomen white with sparse black chromatophores; telsonic segment, uropods and pleopods subhyaline.

Length, 3·1 mm. to 3·7 mm.; greatest width of thorax, ·91 mm. to 1·35 mm.

Hab.—South Australia: Gulf St. Vincent, 7-8 fms. (H. M. Hale). Type, South Australian Museum (Reg. No., C. 198).

A single male, and several Praniza larvae, presumably belonging to the same species, were taken from amongst masses of *Zostera* brought up in the dredge, during a recent excursion of the Field Naturalists' Section of the Royal Society.

The large mandibles, distinctive tubercles, and large excavation of the fore part of the dorsum of the head, are salient characters for this species.

Gnathia pustulosa, n. sp.

Pl. ii., figs. 4-7.

♂. *Head* large, transverse, about one and two-thirds times as wide as medianly long; almost wholly covered with small granules and not divided into areoles; anterior margin a little produced forwards and medianly slightly bilobed; antero-lateral margins incrassate; a longitudinal, mesial furrow on dorsum for about three-fourths of the length, deepest anteriorly, and a shallow fovea on each side of posterior portion of head; hinder margin concave. Eyes

small, their longitudinal diameter about four and one-half times in the width of the head. Superior antennae short and stout; second joint of peduncle a little shorter than first, the third one and two-thirds times as long as second; flagellum five-jointed, the first joint short and the second about as long as the third and fourth together. Inferior antennae damaged; fourth peduncular joint equal in length to second and third together. Mandibles moderately large, not very conspicuous when folded; scoop-shaped on inner surface; less than half as long as the head; superior margin notched towards middle of length.

Thorax.—None of the segments is separated by a constriction. First segment small and narrow, half the width of the head, with the suture distinct; surface granulate. Second distinctly wider than head, expanded on sides, the lateral edges being about twice as long as the medial length; greater part of surface granulate; posterior margin convexly sinuate, medianly a little incised; antero-lateral margins in contact with head. Third wider than any other segment; expanded on sides, the lateral edges more than twice the medial length, which is scarcely greater than that of the first segment; posterior margin concavely sinuate, medianly incised, with edges of incision incrassate; granulate on part of surface. Fourth a little longer medianly than first three together, laterally considerably shorter; anteriorly with a median, submarginal tooth, which fits beneath the incrassate incision of the preceding segment; posterior margin almost straight. Fifth split medianly, each of the halves with a nick at the middle of the length of the inner edge; posterior margin straight. Sixth split medianly; narrowed posteriorly and with lateral portions slightly swollen. Seventh one-fourth as wide as sixth, subrectangular, narrower than abdomen.

Abdomen small, curved beneath the body.

Peraeopods.—First pair operculiform, with the basal joint large, without apparent areolation and with a fringe of short, fine hairs on inner edge; second joint rudimentary. Second to sixth pairs stout, armed with a few blunt spines, tubercles, and hairs.

Pleopods one-half as long as the abdomen, without setae.

Colour (in spirit).—Dirty yellow with granulae and mandibles white. Eyes black.

Length (excluding mandibles), 3·15 mm.; width of head, 1·01 mm.; greatest width of thorax, 1·18 mm.

♀ (distended with ova). *Head* rounded in front, very slightly concave medianly. Eyes about half as long as head.

Peraeopods much more slender than in male.

Thorax.—All of the sutures are discernible, those of the swollen portion (fourth to sixth) rather indistinct. Ova subreniform.

Colour.—White with eggs yellow.

Length, 3·2 mm.; greatest width of thorax, 1·55 mm. Ova: length, ·29 mm. to ·35 mm.; width, ·19 mm. to ·24 mm.

Hab.—South Australia: Glenelg (W. H. Baker). Type, South Australian Museum (Reg. No., C. 199).

A single pair, somewhat mutilated. Some years ago Mr. Baker found these clinging to a sponge washed up near the mouth of the Patawalonga Creek after heavy weather. In both sexes the abdomen is small and curved beneath the thorax; owing to the poor condition of the specimens it is not possible to accurately figure the telson, etc.

Besides the characters given in the introductory key, this species differs from the other three Australian species as follows:—The anterior margin of

the head is not tridentate, as in *G. latidens* and *G. mulieraria*, or excavated, as in *G. ferox*. As in *G. latidens*, the head is almost uniformly tuberculate dorsally, and the fifth and sixth thoracic segments are medianly split; the granules, however, are smaller, the third and fourth thoracic segments are not separated by a constriction, and the mandibles are much smaller than in that species. The dorsum of the head has a median anterior furrow and two posterior foveae, whereas *G. latidens* has only a posterior median groove.

EXPLANATION OF PLATES I. AND II.

PLATE I.

Fig. 1. *Gnathia mulieraria*, male; enlarged 25 diams.
„ 2-4. Dorso-interior, ventral and lateral views of right pseudo-mandible; enlarged 50 diams.
„ 5. Superior and inferior antennae; enlarged 125 diams.
„ 6. First peraeopod; enlarged 50 diams.
„ 7. Second peraeopod; enlarged 50 diams.
„ 8. Terminal segments of abdomen and uropods; enlarged 100 diams.

PLATE II.

Fig. 1. Praniza larva of *Gnathia mulieraria;* enlarged 28·5 diams.
„ 2. Superior and inferior antennae; enlarged 143 diams.
„ 3. Tip of maxilla; enlarged 336 diams.
„ 4. *Gnathia pustulosa*, male; enlarged 28·5 diams.
„ 5. Dorso-interior view of left mandible; enlarged 143 diams.
„ 6. Superior antenna; enlarged 143 diams.
„ 7. First peraeopod; enlarged 57 diams.

STUDIES IN AUSTRALIAN AQUATIC HEMIPTERA. No. IV.[1]

By HERBERT M. HALE.

[Read April 10, 1924.]

The Corixid Genus DIAPREPOCORIS.

PLATE III.

In 1897 Kirkaldy described a Corixid from south-eastern Australia which differed so considerably from any other known species that he erected for its reception the monotypic genus *Diaprepocoris*. Kirkaldy's specimens of the type species are cited as being females, but in 1922 the writer pointed out that superficially the male can be distinguished only when the wings are extended. The abdominal segments in this sex are not strikingly disordered as in other members of the genera of Corixidae; the fifth and sixth dorsal segments are, however, split, and these and the terminal segment are comparatively slightly asymetrical, the irregularity being scarcely discernible on the venter. Also, the male has another sexual character, a curious apparatus, which the writer has supposed to be stridulatory, on the fifth and sixth dorsal abdominal segments.

In his original description Kirkaldy remarks: "Palae bisegmentate. . . . This second segment appears to be a genuine second tarsal segment, not a single claw." The palae of the type species are thin, sublunate, and the inner face is not as deeply spooned, or as widened, as in the majority of the Corixids.

There are now available two other species, which, while undoubtedly congeneric with *D. barycephala,* differ quite considerably in the form of the palae, which approach in shape those of the *Corixa* group; the pronotum in both of the new forms is even more transverse than in the type species.

Prof. Hungerford has proved that, without doubt, most of the water boatmen are largely herbaceous feeders, and that the remarkably modified anterior tarsi (or palae) are excellently formed for the scooping up of decayed vegetable matter, infusoria, etc., from the bottom of ponds. In aquaria Hungerford recommends feeding these bugs with finely-minced water weed, which in a short time encourages the propagation of astonishing quantities of infusoria. The writer has successfully maintained Corixids thus, and it may also be noted that some of our larger forms, such as *Porocorixa eurynome,* readily feed upon mosquito larvae when supplied to them.

One American species of the family, *Cymathia americana*, Hussey, is known to be carnivorous; the palae of *D. barycephala* are structurally somewhat similar to that species. The palae of the other two species described below indicate that their feeding habit is more in accordance with that of most other Corixids. The so-called second tarsal joint of *D. barycephala* seems to be a well-developed palal claw; in *Cymathia americana* the claw is quite as strong.

Ocelli are said to be absent in the Corixidae, but in the three species of *Diaprepocoris* there is a tiny, circular, very slightly convex, blackish area on the notocephalon near the inner margin of each eye; this appears to be a small ocellus, and should be regarded as of generic importance.

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[1] Nos. I.-III. appeared in Rec. S. Austr. Mus., 1922-1924.

DIAPREPOCORIS, Kirkaldy.

Diaprepocoris, Kirkaldy, Ann. Mag. Nat. Hist. (6), xx., 1897, p. 52; Hale, Rec. S. Austr. Mus., i., 1922, p. 328.

Type, *D. barycephala*, Kirkaldy.

This genus may be separated from its allies by the following combination of characters. Notocephalon shining; two ocelli present. Pronotum very short and finely rugose, without transverse lines of colour. Scutellum large, at least three-fourths as wide as the prothorax, dull, clothed with tiny hairs. Hemelytra more or less dull, without small vermiculate or angulate markings; clavus and corium clothed with fine hairs. Palae similar in both sexes, with the terminal claw stout. Face convex in both sexes. Last three visible dorsal segments of abdomen of male asymmetric and split; without strigil, but with a stridulating apparatus, composed of two articles, lying on the fifth dorsal segment, a little to the right of the mid-line of the body.

Distribution (as at present known): Southern and Eastern Australia, Tasmania, and New Zealand.

KEY TO THE SPECIES.

a. Notocephalon about as long as, or slightly longer than, its width at base between eyes, distinctly conically produced in front of eyes. Length, 6 mm. to 8 mm.
  b. Pronotum four to six times wider than medial length. Palae in dorso-lateral view sublunate; interior concave face narrow, with the longest of the hairs fringing the lower margin not longer than greatest width of pala .. .. *D. barycephala*
  bb. Pronotum nine times wider than medial length. Palae in dorso-lateral view falcate; interior concave surface wider, with the longest of the hairs fringing the lower margin much longer than greatest width of pala .. .. *D. zealandiae*
aa. Notocephalon wider posteriorly than medianly long, rounded in front and not much produced in front of eyes. Length, 5 mm. .. .. *D. personata*

DIAPREPOCORIS BARYCEPHALA, Kirkaldy.

Pl. iii., figs. 1 and 5.

Diaprepocoris barycephala, Kirkaldy, *loc. cit.*, p. 53; Hale, *loc. cit.*, p. 329, fig. 350.

Hab.—South Australia, Victoria, New South Wales, and Tasmania.

Diaprepocoris personata, n. sp.

Pl. iii., figs. 2, 4, and 7.

♂. Notocephalon ochraceous, basally suffused with darker colour; rounded in front and a little produced in front of eyes; medial length less than width between intero-posterior angles of eyes; a very obsolete median carina towards base of head. The slightly raised exposed area of pronotum black, reaching to lateral edges of thorax, almost ten times as wide as medial length; very finely rugose, slightly shining; lateral angles acute; anterior margin shallowly, concavely incised in the middle; posterior margin a trifle sinuate. Scutellum brownish-black, finely punctate and clothed with tiny pale hairs; wider than long and three-fourths as wide as prothorax. Hemelytra subopaque; clavus and corium olivaceous-yellow, slightly glossy, moderately densely clothed with black hairs; inner edge of clavus black; membrane sordid yellow, infuscated with blackish on exterior edge, dull, and with an indication of a branching nervure; embolium brownish-black on inner half, narrowly bordered with ochraceous on external edge. When folded the hemelytra appear black owing to the dark colour of dorsum of abdomen. Legs ochraceous, the intermediate tarsi apically blackish; swimming hairs of posterior legs dark brown. Palae falcate in dorso-lateral view; fringing hairs of interior scoop brownish; anterior tibiae with a

few small spines, closely embracing base of palae; anterior femora with three or four short and stout spines on dorsal side near apex; and with inner face (against which the tibiae fits when the leg is flexed) flattened and somewhat excavate. Intermediate claws subequal in length to tarsi.

Length, 5 mm.; width of prothorax, 1·9 mm.

♀. Length, 5 mm.; width of prothorax, 2 mm.

Hab.—Western Australia: Swan River (type loc.) and Mundaring (J. Clark).

The short head, very transverse pronotum, and falcate palae are the salient features of this species when compared with *D. barycephala.* The stridulatory apparatus on the abdomen of the male is exactly as in the last-named species.

Only two examples were collected; the type was taken by Mr. Clark from the nest of an ant *(Iridomyrmex conifer)* which he was engaged in working for inquiline Coleoptera.

Diaprepocoris zealandiae, n. sp.

Pl. iii., figs. 3 and 6.

♀. Notocephalon testaceous, conically produced in front of eyes, its width at base between eyes about equal to the medial length; with a very obsolete carina towards base of head; posterior margin of head almost evenly concave. The slightly raised area of pronotum ochraceous, not reaching to lateral edges of thorax and nine times as wide as medial length, rugose, the rugae subnitid; lateral angles subacute; anterior margin shallowly concavely incised medianly and posterior margin very slightly sinuate. Scutellum testaceous, finely rugose, and clothed with very short, sparse pubescence; wider than long and three-fourths as wide as the prothorax. Hemelytra sordid yellow; clavus and corium clothed with fine golden hairs, longer than those of scutellum; embolium ochraceous, a little infuscated on inner half. Legs testaceous. Palae falcate in dorso-lateral view; anterior tibiae closely embracing base of palae. Intermediate legs rather stout.

Length, 6·1 mm. wide; width of prothorax, 2·1 mm.

Hab.—New Zealand (Pascoe Coll., in British Museum).

A single, somewhat damaged specimen of this species is before me. It superficially resembles *D. barycephala,* but the form is slightly more elongate, the pronotum is shorter, and the palae are very different. It may be separated from *D. personata* by the larger and more conically produced head, the narrower and more rugose pronotum, etc.

EXPLANATION OF PLATE III.

Fig. 1. *Diaprepocoris barycephala,* male, from Lucindale, South Australia.
„ 2. *Diaprepocoris personata,* male, from Swan River, Western Australia.
„ 3. *Diaprepocoris zealandiae,* female, from New Zealand.
„ 4. Dorsum of abdomen of *D. personata,* male.
„ 5. Anterior leg of *D. barycephala,* male.
„ 6. Anterior leg of *D. personata,* male.
„ 7. Anterior leg of *D. zealandiae,* female.

Figs. 1 to 4 enlarged 11 diameters; figs. 5 to 7 enlarged 36 diameters.

THE FLORA AND FAUNA OF NUYTS ARCHIPELAGO AND THE INVESTIGATOR GROUP.

No. 15.—THE PEARSON ISLAND RAT AND THE FLINDERS ISLAND WALLABY.

By F. Wood Jones, D.Sc., F.Z.S.,
Professor of Anatomy in the University of Adelaide.

[Read April 10, 1924.]

Since the other papers of this series (Nos. 2 and 6) that deal with Mammals were written, two further mammalian forms have been added to the list of the island fauna. In both cases these animals belong to new species confined, so far as is known, to the islands upon which they were obtained.

The Pearson Island Rat.

In contribution No. 2, on the Monodelphian Mammals (vol. xlvi., 1922, p. 191), it was noted that "Pearson Island is probably the home of two Murines, and it is hoped that these species may one day be made known to science." It was suggested that two species were present because during a visit to the island on February 16, 1922, the present writer saw a rat, which appeared to be dark, almost bluish, in colour, between two granite boulders on Middle Island, and another member of the party reported having seen a light fawn-coloured rat on the open slope of North Island. As a result of fairly extensive trapping on the group during the longer visit of 1923, I have now no doubt that there is only one species of rat present, and the different impressions of the animal conveyed to two observers were due to different circumstances under which the brief view of the specimens was obtained. As a matter of fact, neither description is correct; the rat is not dark and bluish, as it appeared in the deep shade, nor is it pale and fawn coloured, as it appeared in the brilliant sunlight. Specimens captured during the 1923 visit were sent to Mr. Oldfield Thomas, at the British Museum, and by him they were described and named, in compliment to Sir George Murray, *Rattus murrayi*. The original description of the type specimen (Ann. and Mag. Nat. Hist., Ser. 9, vol. xi., p. 601, May, 1923) is as follows:—

Rattus murrayi.

"Most nearly allied to *R. greyi* of the mainland. Size about as in that animal. Fur fine and soft. General colour greyish washed with buffy-brown, the grey showing through the brown more than in *R. greyi*, and the general tone consequently paler. Under surface drabby-grey, the hairs broadly slaty at base, their tips drabby-whitish; line of demarcation scarcely marked. Hands and feet white, with a certain darkening on the metopodials and digits which is not present in *R. greyi*. Tail rather shorter than in *R. greyi*, but imperfect or diseased in most of the specimens, this being, perhaps, due to severe competition in a small island.

"Skull essentially similar to that of *R. greyi*, with similarly reduced supraorbital ridges; but the palatal foramina are more widely open and the bullae are rather larger, the latter a character one would not expect to find in an island animal. Molars conspicuously smaller than in *R. greyi*, and, indeed, far smaller

in proportion to the skull than in the great majority of the species of *Rattus*. Dimensions of the type (measured on the spirit-specimen before skinning):—Head and body, 134 mm.; tail, 116; hind foot, 28; ear, 19. Skull: greatest length, 36·4; condylo-incisive length, 34; nasals, 14·6; interorbital breadth, 5; breadth of brain case, 15·2; palatal foramina, 7·5x3; length of bullae, 6·7; upper molar series, 5·1.

"This distinct species is readily recognizable by its pale colour, shortened tail, large bullae, and, most of all, by its unusually small teeth."

This little rat lives almost everywhere upon the three partially detached portions of the main island. Upon the South Island the whole of the travertine plateau is traversed by runaways which lead, radiating fashion, from central burrows which usually open into a large ramifying excavation beneath a slab of travertine. The runs are well beaten down, and traps set in them never failed to catch. Upon the open travertine plateau the rats seem mainly to feed upon the *Mesembryanthemum*, and none of their hollows beneath the travertine pavement contained any store of food.

On the Middle Island, and again on the larger North Island, the bulk of the rat population is centred on the travertine plateaux; but large communities also live among the great granite boulders. Wherever they shelter during the day time, the limestone flats, covered with pig-face and low saltbush, seem to provide their nocturnal playground and their source of food. In the one spot, on the southern and eastern side of Middle Island, where there is a sandy beach, the rats also come down to the sea shore every night to forage over the sand above the tide mark. Although, in the deep shade of the spaces between the great granite boulders, it is usually possible to see a specimen or two in the day time, the rats are distinctly crepuscular and nocturnal creatures, and as soon as dusk comes the travertine plateaux become alive with them. An evening rat hunt provided a never-failing source of amusement for the party camped on the island in 1923.

The animal proved to be ridiculously easy to trap, and in this it showed a very marked contrast to *Leporillus jonesi*, on Franklin Island. Cage traps set about the camp could be emptied and reset several times during the evening, and almost any bait—oatmeal, cheese, bacon, or bread—seemed to attract the rats. Those brought back alive lived well in captivity and proved to be very gentle and contented little animals; but, unfortunately, they did not breed. As in the case of some other animals observed in the islands, the males seem to vastly outnumber the females, and a very large proportion of the rat population shows varying degrees of mutilation of the tail. The general appearance of *R. murrayi* is very characteristic; its small size, fluffy coat, and small white hands and feet make it an attractive little animal. It is also remarkably gentle, and fresh-caught animals can be handled, if they are not unduly alarmed or roughly grasped, without fear of their biting. They thrive on any vegetable diet, but seem to be short lived, none of them remaining alive a year after capture and all of them showing well-marked signs of old age before they died.

The Flinders Island Wallaby.

In contribution No. 6, on the Didelphian Mammals (vol. xlvii., 1923, p. 92), it was recorded that the wallaby, which Flinders had seen on this island, and which was generally supposed to have become extinct, was, in fact, still living in small numbers upon the northern point of the island. During our stay on the island, in January, 1924, several specimens were seen and a male was shot and a female snared. The wallaby is one of the Dama group of the section *Thylogale*, and its cranial and external characters are sufficiently distinct from

those of other described members of the group to warrant its description as a new insular species. The animal is accordingly described here.

Thylogale flindersi, n. sp.

The description of the type, male, specimen is as follows:—

This is a gracefully-built wallaby of a general grizzled silver-grey colour.

It differs from the Kangaroo Island wallaby in being more finely built and considerably less sturdy. The head is small in proportion to the body, and the whole animal elegant compared with the thick-set wallaby of Kangaroo Island. The coat has a texture altogether different, in that it is fine, rather short and sleek, and lacks the woolly or fluffy appearance typical of *T. eugenii.*

In general colour it is markedly grizzled light grey, becoming strongly rufous over the shoulders in the male. The hairs of the mid-dorsal region measure 20 mm., and the long, entirely black, hairs which are so conspicuous in *T. eugenii* are absent. The individual hairs are banded with white instead of buff, and the majority of them lack the dark tip.

The face is grey, with a well-marked pale area extending along the upper lip to beneath the eye. Dorsal surface of the body, pepper-and-salt grey. Sides and back of neck and shoulders rather bright rufous in the male, tawny in the female. Upon the occiput there starts a dark mid-dorsal stripe; this stripe is very pronounced in the male and may be traced to the lower dorsal region. Chin and throat greyish-white; but the lower part of the neck, chest, and abdomen coloured almost as the dorsal surface, save that the pepper-and-salt mixture is somewhat lighter. Limbs pale fawn. Tail pale grey.

In the living animal the ears are pinkish-yellow within and but little hairy; without, they are clothed by dark-grey hairs. Vibrissae, etc., as in *T. eugenii.*

The skull is lightly built and is at once distinguished from that of *T. eugenii* by the narrow nasal bones, the outer margins of which are straight, or nearly so, in contrast to the sinuous outer margins of these bones in *T. eugenii.* The average breadth of the nasal bones is 13·7 mm. in *T. flindersi* as opposed to 19 mm. in the Kangaroo Island wallaby. The constriction of the interorbital region is also considerably narrower than that typical of the latter animal. In *T. flindersi* the average minimum breadth of the interorbital constriction is 14·2 mm. as opposed to 17·1 mm. in the other species. In the form of the nasal bones *T. flindersi* resembles *T. billardieri.*

Dimensions.	Type of Species: Male.	Female.
Head and body	570	510
Tail	410	340
Hind foot	132	118
Ear	47	50

DIMENSIONS OF SKULL.

	Male. Adult. Type:	S.A. Mus. No. 1751	Adult.	Adult.	Adult.	S.A. Mus. No. 1750	Adult.	S.A. Mus. No. 1749	Adult.
Basal length ..	95	92	88	87	85	85	84	84	79
Breadth	53	49	49	49	49	49	—	46	47
Nasals, length ..	38	36	34	34	34	32	—	34	33
Nasals, breadth ..	16	16	12	14	13	12	—	14	13
Interorbital breadth	14	14	13	14	14	15	14	15	15
Palate length ..	59	51	53	54	51	50	50	50	49
Diastema	20	19	17	19	19	19	17	17	19
M1-M3	18	17	18	16	18	16	18	15	15

For the purposes of comparison the following tables give measurements of skulls of *T. eugenii* from Kangaroo Island and from the mainland of South Australia:—

KANGAROO ISLAND SPECIMENS.

	Average of 50 male skulls.	Average of 40 female skulls.
Basal length	98·8	94·8
Breadth	54·5	52·8
Nasals, length	38·7	36·4
Nasals, breadth	19·2	18·9
Palate length	59·8	57·3
Interorbital constriction	17·1	17·1
Diastema	22·2	20·7
M1-M3	19	19

MAINLAND SPECIMENS: SOUTH AUSTRALIAN MUSEUM SKULLS.

	Pt. Linc'ln No. 1748	Tickera No. 1755	Pt. Linc'ln No. 1740	Pt. Lincl'n Male. No. 1746
Basal length	92	88	84	82
Breadth	50	50	48	50
Nasals, length	35	35	35	30
Nasals, breadth	18	16	16	16
Palate length	54	51	55	55
Interorbital constriction	16	16	14·5	17·5
Diastema	23	17	20	22
M1-M3	17	17	17	15

Flinders observed this animal in 1802, and he states that on the island "a small species of kangaroo, not bigger than a cat, was rather numerous. I shot five of them, and some others were killed by the botanists and their attendants and found to be in tolerably good condition." Even comparatively recently the animal was very numerous, and it has been reported that as many as thirty thousand were at one time killed on the island. In 1910 a destructive bush fire swept the portion of the island occupied by wallabies, and when I visited the place in 1920 no trace of them was to be found, and the tenant of the island believed them to be extinct. In 1922 I again visited the island and found obvious evidence of their presence, but no actual specimen was seen.

During the time spent in camp on the island, in 1924, the study and collection of this wallaby were the principal objects to which I devoted attention. The tracks were again found in the same restricted area, and on the first visit to the spot one was heard to thump in the dense ti-tree which covers this, the northern, corner of the island. Owing to the thick growth of ti-tree it was extremely difficult to observe the animals or to shoot them, and without previous preparation, the site was not an easy one in which to snare. Only three animals were actually seen by the writer, and one, a male, was shot and a female snared. The animal is obviously more agile and quicker in its movements than the examples of *T. eugenii*, living on Kangaroo Island, and it appears to be a more elegant creature when moving about.

The present small colony of wallabies occupies only a very restricted area upon which the native bush has not been destroyed by various attempts at cultivation. Although it probably contains a hundred or so individuals, its hold on life cannot be considered a very secure one. The animals are always at the mercy of bush fires, having no line of retreat, since they live on a corner of the

island that is girt by high and inaccessible cliffs. Moreover, they have to contend against two introduced animals, the feral domestic cat, which has overrun the island, and the rabbit. They may at any time, though fortunately this does not seem to be at present the case, have to contend against human enemies. In January, 1924, the young were entirely independent of their mothers. On account of its build being rather more elegant than that of the thick-set Kangaroo Island wallaby, it was at one time a favourite with people who cared to have wallabies running in their grounds, but at present I believe there are no descendants of these animals living on the mainland. It has also been an inhabitant of the Zoological Gardens in Adelaide, but no specimens have been exhibited there for many years.

As mentioned in the previous paper (No. 6), a former tenant of the island (Mr. May) has assured me that when the wallabies were numerous there were two distinct types living on the island, the one obviously that described as *Thylogale flindersi,* and the other a more rare, slender, yellow wallaby. What this second animal was it is impossible to guess; there seem to be no traces of it left.

ON AUSTRALIAN ANOBIIDES (COLEOPTERA).

By Arthur M. Lea, F.E.S., Entomologist, South Australian Museum.

(Contribution from the South Australian Museum.)

[Read May 8, 1924.]

The species of the subfamily Anobiides of the Ptinidae, although including some important ones from an economic point of view, are nearly all small and dingy, and specimens of the sections Xyletininae and Dorcatominae are difficult to manipulate, so that parts of the under surface may be clearly seen, yet these must be examined before the genera can be noted with certainty. Very few Australian species of the subfamily have been previously named. The generic details given by Lacordaire (1) appear of little use, as he seldom mentioned parts of the under surface, in particular of the head and sterna, by which the Australian genera may be most satisfactorily distinguished; so for the main divisions reliance has been placed on Leconte and Horn.(2) That many of our genera occur in other parts of the world is certain, apart from introduced ones, so that some notes on generic features may be useful; the generic table, however, was prepared solely with a view to convenience of identification. Recently (3) a list was given of the species of the Ptinides, and it seems now desirable to give one of the Anobiides, based on M. Pic's catalogue of the subfamily.(4)

DRYOPHILINAE.

Dryophilodes australis, Blackb.
" insignis, Blackb.
Dryophilus (5)

ERNOBIINAE.

Ernobius mollis, Linn.(6)

ANOBIINAE.

Sitodrepa panicea, Linn.
Anobium punctatum, De Geer.
" *domesticum*, Fourc.
Hadrobregmus australiensis, Pic.
Trypopitys
Pronus magniventris, Lea
" medianus, Lea

PTILININAE.(7)

XYLETININAE.

Lasioderma serricorne, Fab.

DORCATOMINAE.

Calymmaderus australiensis, Pic.
Thaptor (8)
Dorcatoma lanigera, Oll.(9)
Caenocara

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(1) Lacordaire, Gen. des Col., iv.
(2) Leconte and Horn, Class. Col. N. Am., 1883, in Smithsonian Misc. Col., No. 507.
(3) Lea, Trans. Roy. Soc. S. Austr., 1917, pp. 146, 147.
(4) Pic, in Junk's Col. Cat., part 48, Berlin, 1912.
(5) Olliff, Proc. Linn. Soc. N.S. Wales, 1888, p. 1512, records this genus as Australian, but without naming a species.
(6) Recorded as cosmopolitan, but specific Australian localities are herein noted.
(7) A new genus of the section herein noted *(Deroptilinus)*.
(8) Recorded by Pic as a synonym of *Calymmaderus*.
(9) Olliff, *l.c.*, p. 1511, overlooked by Pic; but herein proposed as the type of a new genus, *Aulacanobium*.

Australian Genera of Anobiides.

A. Head free, front coxae level with intercoxal process.	
a. Antennae simple	*Dryophilodes*
aa. Antennae with three apical joints greatly enlarged	*Ernobius*
AA. Head with sides capable of being received in prosternal excavations, front coxae strongly projecting.	
B. Antennae with four joints ramose	*Deroptilinus*
BB. Antennae with three apical joints not greatly enlarged (the apical one at most moderately enlarged).	
b. Mesosternum with an open cavity, continued on to metasternum, for reception of antennae	*Trypopitys*
bb. Mesosternum not cavernous.	
c. Base of lower surface of head deeply bisinuate for reception of antennae	*Lasioderma*
cc. Base not bisinuate or cavernous.	
d. With regular series of punctures on elytra	*Tasmanobium*
dd. Without such	*Secretipes*
BBB. Antennae with three apical joints much longer, and usually much wider, than the preceding ones.	
C. Base of lower surface of head deeply bisinuate for reception of antennae.	
e. Two basal joints of club each with a long ramus	*Aulacanobium*
ee. Club not ramose.	
f. Each side of prosternum with an exposed triangle	*Dicoelocephalus*
ff. Legs concealing sides of prosternum	*Deltocryptus*
CC. Base of lower surface of head not deeply bisinuate.	
D. Without a concealed sternal cavity.	
g. Mesosternum and metasternum with an open median cavity, common to both	*Anobium*
gg. Sterna without an open median cavity.	
h. Rear flanks of prosternum oblique	*Sitodrepa*
hh. Rear flanks vertical	*Pronus*
DD. Front and middle coxae separated to allow passage of antennae into a concealed sternal cavity.	
E. First joint of club longer than two following combined ..	*Calymmaderus*
EE. First joint shorter.	
F. First joint of club of male with a process more than twice as long as its support	*Caenocara*
FF. Process not twice as long as its support	*Dorcatoma*

Notes on Table.

aa. *Dryophilus* is allied to *Ernobius*, but I have not seen any Australian species, although Olliff records the genus as occurring in New South Wales.

AA. The head is usually seen resting on the breast, concealing part or all of the front legs.

Hadrobregmus has been recorded as Australian, but *H. australiensis* is an *Anobium*.

Dryophilodes.

The numerous small and dingy species, which I refer to this genus, certainly all belong to the Dryophilini, but it is probable that they will eventually be referred to several genera when the species can be compared with associated ones occurring elsewhere, and particularly with the New Zealand genus *Sphinditeles*, and similar genera, but at least they may all be referred to *Dryophilodes* by the generic table given herein. Much importance in the group is sometimes attached to the sides of the prothorax, so that *D. serricornis* and *D. marginicollis*, whose prothoracic margins are conspicuously wider than on all others, are almost certain to be considered as belonging to a different genus, or to two different genera. In the event of the genus being split up, *D. subcylindricus, D. vigilans, D. angustus,* and *D. minor* should be kept together, and *D. politus* and *D. subopacus,* which are certainly close to *Sphinditeles,* should also be kept together. The prothorax of many species, as viewed from in front, appears to have the

sides evenly arcuate from the base to the middle, then evenly rounded to the apex, but when viewed from behind, or from directly above the scutellum, each side appears to be acutely produced in the middle, or even spinose; but the apparent acuteness varies so much with the point of view, and the gradations between the extremes of the genus are so gradual, that they cannot be employed for the major divisions of a table, although often useful for distinguishing some of the species. The hind angles are sometimes produced to the sides, when, if small, they are not easily seen, and so the prothorax may appear to have obtuse basal angles, sometimes they are produced slightly backwards, on to the elytra near the shoulders, on such specimens they usually appear decidedly acute, although they may be actually 90 degs. or more. On most species the hind angles are more densely clothed than the rest of the prothorax, frequently appearing whitish, but as the pubescence is easily abraded or disarranged not much reliance can be placed upon it; the density of the pubescence also makes an apparent difference, except on close examination, to the degrees of the angles and the arcuation of the sides. The lineate arrangement of the elytral punctures is conspicuous on some species, and faintly or not at all traceable on others, but, even when not traceable elsewhere, a faint lineate arrangement on the basal slope may appear or disappear from various points of view. I have not usually considered it necessary to describe more than the colour of the under surface, but the parts of all species were examined; the apical half of the metasternum has a deep median line, and, unless otherwise mentioned, the apical segment of the abdomen is either flat, or has a more or less shallow median impression; it may sometimes be used for distinguishing the sexes, but not commonly so. All the species have the head with small crowded punctures, often partially concealed by pubescence. The eyes are always prominent, but vary in size from small to moderately large. Many of the species may be beaten from eucalyptus foliage affected by various kinds of gall-insects.

Table of Species of Dryophilodes.

- A. Elytral pubescence forming more or less conspicuous markings.
  - *a.* Elytral pubescence mostly pale, with a large dark patch on suture.
    - *b.* Sutural patch as in fig. 1 .. .. *insignis*
    - *bb.* Sutural patch as in fig. 2 .. .. *pyrifer*
    - *bbb.* Sutural patch as in fig. 3 .. .. *sagittifer*
  - *aa.* Elytral pubescence not as in *a.*
    - *c.* Pubescence in irregularly alternate golden and white vittae .. *pictus*
    - *cc.* Three transverse series of small spots .. .. *latus*
- AA. Elytral pubescence uniform or almost so.
  - B. Antennae conspicuously serrated .. .. *serricornis*
  - BB. Antennae filiform, or at most feebly serrated.
    - C. Sides of prothorax distinctly arcuate towards base, hind angles acute.
      - *d.* Basal third of prothorax completely clothed with white pubescence .. .. *basicollis*
      - *dd.* Base of prothorax without white pubescence, or only in angles.
        - *e.* Elytral pubescence longer than usual, and lineate in arrangement .. .. *pilipennis*
        - *ee.* Elytral pubescence short and uniform.
          - *f.* Elytral punctures not distinctly seriate in arrangement on basal half.
            - *g.* Apical segment of abdomen conspicuously bifoveate .. *bifoveiventris*
            - *gg.* Abdomen not bifoveate.
              - *h.* Prothorax not at all black.
                - *i.* Sides of prothorax viewed directly from above conspicuously angulate in middle.
                  - *j.* Size moderate .. .. *squalidus* (in part)
                  - *jj.* Size small .. .. *orthodoxus*
                - *ii.* Sides of prothorax, so viewed, not angulate in middle .. .. *metasternalis*

hh. Prothorax partly or entirely black.
k. Without a finely impressed line at base of pronotum — *murinus*
kk. A finely impressed line at base of pronotum.
l. All joints of antennae conspicuously longer than wide .. .. *acuticollis*
ll. Some of the median joints of antennae very little or not at all longer than wide.
m. Size moderate .. .. *squalidus* (in part)
mm. Size minute .. .. *parvoniger*
ff. Elytral punctures, at least on basal half, more or less seriate in arrangement.
n. Prothorax black.
o. Bases of prothorax and of elytra of two contrasted shades of colour .. .. *brunneipennis*
oo. Bases similarly coloured.
p. Length less than 3 mm. .. .. *apicipennis*
pp. Length 3 mm. or more.
q. Elytra more than thrice the length of prothorax *eucalypti*
qq. Elytra not thrice the length of prothorax .. *acutangulus*
nn. Prothorax at most dark brown.
r. Each elytron at base wider than median length of prothorax .. .. *brevicollis*
rr. Each elytron narrower than median length of prothorax.
s. Seriate punctures of elytra not distinct to middle .. *subhumeralis*
ss. Seriate punctures distinct to beyond middle.
t. Sides of prothorax, as viewed obliquely from behind, apparently spinose.
u. Interstices on basal half of elytra asperate-punctate or granulate .. .. *rufobrunneus*
uu. Interstices there smoother .. .. .. *seriatus*
tt. Sides of prothorax, viewed as in *t*, not apparently spinose.
v. Elytra quite parallel-sided from behind shoulders to near apex.
w. Elytral pubescence extremely short (dust-like) *pulverulentus*
ww. Elytral pubescence short but not abnormally so.
x. Interstices between rows of punctures with a granulated appearance .. .. .. *interstitialis*
xx. Interstices without a granulated appearance *flavipalpis*
vv. Elytra with slightly rounded sides .. .. *melanostethus*
CC. Sides of prothorax scarcely or not at all arcuate towards base, hind angles 90 degs. or more.
D. Elytral punctures not distinctly lineate in arrangement.
y. Thin .. .. *subcylindricus*
yy. Comparatively robust.
z. Greatest width of prothorax slightly more than that of of elytra .. .. *fumosus*
zz. Greatest width of prothorax not more than that of elytra
a. Derm of elytra not black .. .. *robustus*
aa. Derm of elytra black, except on part of apical slope.
b. Pubescence short and depressed .. .. *niger*
bb. Pubescence longer and looser .. .. *pullatus*
DD. Elytral punctures more or less distinctly lineate in arrangement.
E. Comparatively robust.
c. Pubescence white or almost so, and very dense .. .. *albatus*
cc. Pubescence darker and less dense.
d. With two shallow medio-basal depressions on pronotum *multiseriatus*
dd. Without such.
e. Derm of prothorax and elytra of two contrasted shades of colour.
f. Elytra scarcely twice as long as wide .. .. *latipennis*
ff. Elytra more than twice as long as wide .. .. *brevicornis*
ee. Derm of prothorax and elytra not of contrasted shades of colour.

g. Prothorax with conspicuous lateral margins ..	*marginicollis*
gg. Prothorax with feeble lateral margins.	
h. Prothorax with denser and paler clothing on hind angles than on disc	*ubiquitosus*
hh. Prothorax without special clothing on hind angles.	
i. Prothorax black	*obscuripennis*
ii. Prothorax not black.	
j. Size minute	*abjectus*
jj. Size larger.	
k. Many joints of antennae scarcely longer than wide	*australis ?*
kk. All joints except the second distinctly longer than wide	*subapicalis*
EE. Comparatively thin.	
F. Prothorax entirely black.	
l. Seriate arrangement of elytral punctures feeble.	
m. Pubescence very short and depressed	*vigilans*
mm. Pubescence longer and sloping	*planicollis*
ll. Seriate arrangement of elytral punctures distinct.	
n. Greatest width of prothorax equal to base of elytra ..	*nigrinus*
nn. Greatest width of prothorax less than base of elytra.	
o. Upper surface shining	*politus*
oo. Upper surface subopaque	*subopacus*
FF. Prothorax at most partly black.	
G. Greatest width of prothorax equal to base of elytra.	
p. Pubescence very short and depressed	*angustus*
pp. Pubescence with a looser appearance	*minor*
GG. Greatest width of prothorax less than base of elytra.	
H. Prothorax from some directions with a distinct median line	*cribripennis*
HH. Without such.	
I. Lineate arrangement of elytral punctures distinctly traceable to beyond the middle	*parvicollis*
II. Lineate arrangement not traceable to middle; size much smaller	*pallidus*

Notes on Table.

aa. Specimens of these species, in good condition, are very distinct, but the pubescence appears to be easily disarranged or abraded.

C. The point of view should be from immediately above the scutellum; on these species the arcuation of the sides of the prothorax is distinct in itself, although sometimes apparently enhanced by clothing, the hind angles are also less than 90 degs. Seen from behind the sides appear angulate in middle. On the species of CC the clothing may sometimes cause the sides to appear arcuate, although they are really not so, and the angles are usually more than 90 degs. When the angles are greasy or dusty, however, it is sometimes difficult to decide as to their degrees; *D. parvoniger* at first glance appears to have the hind angles more than 90 degs., but on close examination they are seen to be acute, with the sides before them arcuate.

f. In some lights about the basal fourth of *D. squalidus* a faint lineate arrangement appears from certain directions, but on the species of *ff* the seriate arrangement is fairly distinct to the middle, or beyond it.

g. This character may be confined to the male, but the species is otherwise distinct..

i. On these species, as on many others of the genus, the sides of prothorax when viewed from directly above or behind the scutellum, appear to be quite strongly angulate in the middle, or even almost spinose, but on altering the point of view to a more frontal one this appearance is lost.

ii. All the specimens referred to *D. metasternalis* appear to belong to but one species, but on some of them a faintly lineate arrangement of the punctures

may be traced. The hind angles, viewed from above the scutellum, certainly appear slightly less than 90 degs., but the arcuation of the sides before the base is feeble.

q. There are other differences between *D. eucalypti* and *D. acutangulus,* particularly in the pronotum and length of antennae, but the comparative lengths of the prothorax and elytra are at once apparent when specimens of the two species are placed side by side.

r. This is a comparatively robust species, but to appreciate the character used to distinguish it from those of *rr,* it is necessary to hold specimens at such a point that the front edge of the prothorax is clearly visible.

s. It was with some doubts that this species was placed with others of *ff,* as the seriate punctures are but feebly defined even near the base. The specimens, however, have a dark or velvety patch on each side behind the shoulder, that is fairly distinct from some directions, although it is not due to pubescence.

t. On these species the sides of the prothorax, from an angle of about 45 degs. behind the scutellum, appear to be very sharp, even spinose; on those of *tt,* from the same point of view, the sides appear to be moderately produced, but certainly not spinose.

z. D. fumosus was somewhat doubtfully placed here; see notes under its description.

DD. The lineate arrangement of the elytral punctures is usually sufficiently distinct on the basal half, but on many species it becomes vague posteriorly, and on a few it is not very sharp even towards the base, although a lineate arrangement is certainly traceable in parts.

ee. This may only refer to the base of the elytra, which is as dark as the prothorax.

GG. The two species here associated are sufficiently distinct when placed side by side, but it is rather difficult to define the differences except in length and clothing; there are eight of *D. minor* before me, all taken together, on some of them the prothorax is black with only the front edge obscurely reddish, so that they might have been referred to F, where they would be associated with *D. vigilans,* a much larger and otherwise different species.

Dryophilodes australis, Blackb.

A Victorian specimen, measuring 3 mm., was standing in the Blackburn collection as *D. australis,* although without a name-label actually transfixed by its pin. It differs from the description in being of an uniform dull castaneous-brown (not piceous with some parts paler), and with fairly large and close-set rows of punctures, distinct to well beyond the middle (on the sides almost to the apex); the elytra were described as *"obsoletissime striatis,"* and those of the specimen in question might fairly be so regarded in comparison with other beetles, but for the genus the rows are unusually distinct. The specimen has been included in the table as *australis ?,* as its identity is certainly doubtful.

Dryophilodes insignis, Blackb. Fig. 1.

One of the few strikingly marked species of the subfamily. It varies somewhat in size, and is widely distributed, specimens before me being from northern Queensland, New South Wales (Wollongong, National Park, Forest Reefs), Victoria (Nelson), South Australia (Gawler, Mount Lofty, Port Lincoln), and Western Australia (Garden Island).

Dryophilodes pyrifer, n. sp. Fig 2.

Piceous-brown, abdomen and parts of legs obscurely reddish. Densely clothed with whitish scales, obscurely variegated on head and prothorax, elytra with a conspicuous somewhat pear-shaped velvety patch of darker scales, and with faint stripes, three median segments of abdomen each with a conspicuous apical fringe.

Head with large prominent eyes. Antennae with second joint rather small, third to tenth subequal in length but slightly diminishing in width, eleventh about half as long again as tenth. Prothorax not much wider than long, sides slightly arcuate towards base, hind angles somewhat acute, densely and finely granulate. Elytra distinctly wider than prothorax, parallel-sided to near apex; with regular rows of punctures, almost concealed by clothing. Length, 4 mm.

Hab.—Tasmania: Stanley, on top of "Nut" (A. M. Lea).

At first glance apparently belonging to *D. insignis,* but decidedly larger, prothorax longer in proportion, and velvety patch of elytra with a parallel-sided extension to about one-fourth from the base. The head of the type has not been abraded, but appears to be densely granulate or punctate; where the prothorax has been abraded it is seen to be closely covered with small granules.

Dryophilodes sagittifer, n. sp. Fig. 3.

Piceous-brown, abdomen, legs, and antennae more or less obscurely reddish. Densely clothed with white or whitish scales, on the upper surface variegated with fawn-coloured ones; the elytra, in addition, with a conspicuous velvety patch in middle.

Eyes rather large and prominent. Antennae moderately long. Prothorax not much wider than long, sides moderately rounded, gently arcuate towards base, hind angles almost square, derm concealed. Elytra rather narrow, distinctly wider than prothorax, parallel-sided to near apex; with rows of normally almost concealed punctures. Length, 2·75-3 mm.

Hab.—Queensland: Dalby (Mrs. F. H. Hobler); New South Wales: Sydney (A. M. Lea).

A beautiful little insect, allied to *D. insignis,* and the preceding species, but smaller, and with the velvety patch of different shape, being acutely produced in front and notched posteriorly, so as to be shaped somewhat like an arrow-head; it is also usually conspicuously bordered by snowy scales; beyond the velvety patch each elytron has white and fawn-coloured scales (varying in extent with the specimen), and with darker patches sublineately arranged, as if remnants of vittae. The derm of the head and prothorax is normally concealed, but is apparently covered with small punctures or granules. The hind angles of the prothorax, viewed from above the scutellum, appear to be square, but from a point perpendicular above each, they are seen to be slightly more than 90 degs.

Dryophilodes pictus, n. sp.

Reddish-castaneous. Clothed with golden-red and whitish pubescence, more or less vittate on elytra; under surface with whitish pubescence.

Antennae moderately long, second joint small, none of the others transverse. Prothorax moderately transverse, sides scarcely arcuate towards base, hind angles slightly more than 90 degs.; punctures crowded, small, and normally concealed; with a faint median line. Elytra slightly wider than prothorax, not quite parallel-sided; with dense punctures, nowhere distinctly seriate in arrangement. Length, 3·25-4 mm.

Hab.—South Australia: Adelaide (J. G. O. Tepper), Tumby Bay (Rev. T. Blackburn), Ooldea (A. M. Lea); Western Australia: Swan River (Lea).

A robust species. On specimens in good condition the pubescence is beautifully variegated, but on partial abrasion it appears speckled, instead of longitudinally striped. On the specimens from Tumby Bay and Ooldea the metasternum is almost black, on the others it is not at all, or scarcely, darker than the abdomen.

Dryophilodes latus, n. sp.

Castaneous-brown, metasternum and other parts sometimes darker. Moderately clothed with somewhat yellowish pubescence, becoming white on under surface, and obscurely maculate on elytra.

Antennae moderately long. Prothorax about once and two-thirds as wide as long, sides moderately rounded, hind angles more than 90 degs., median line faint; punctures crowded and small. Elytra slightly wider than widest part of

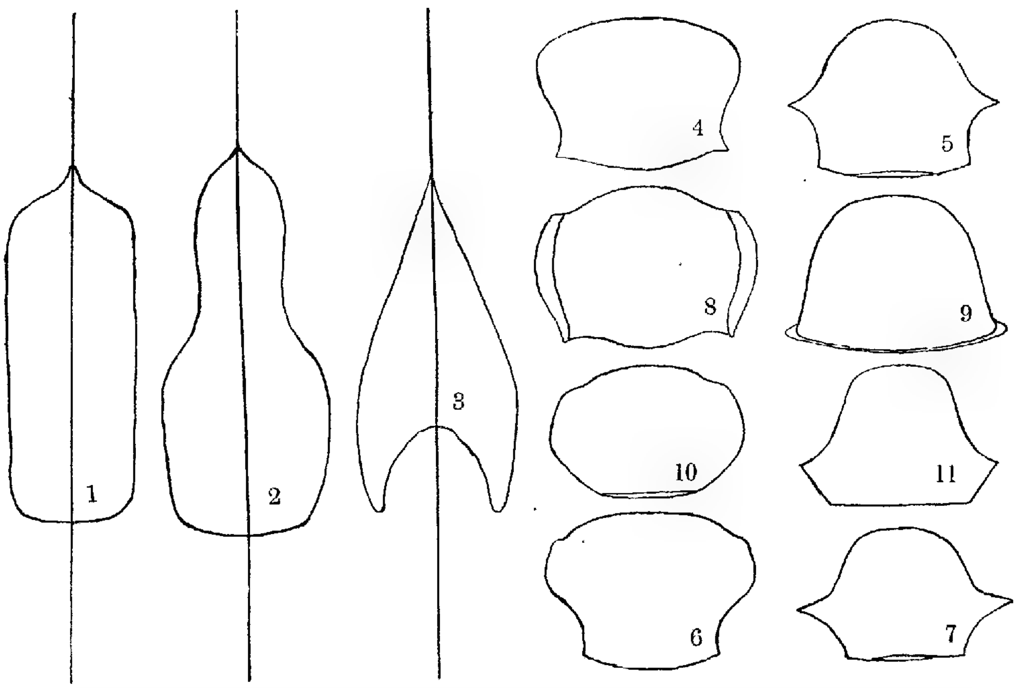
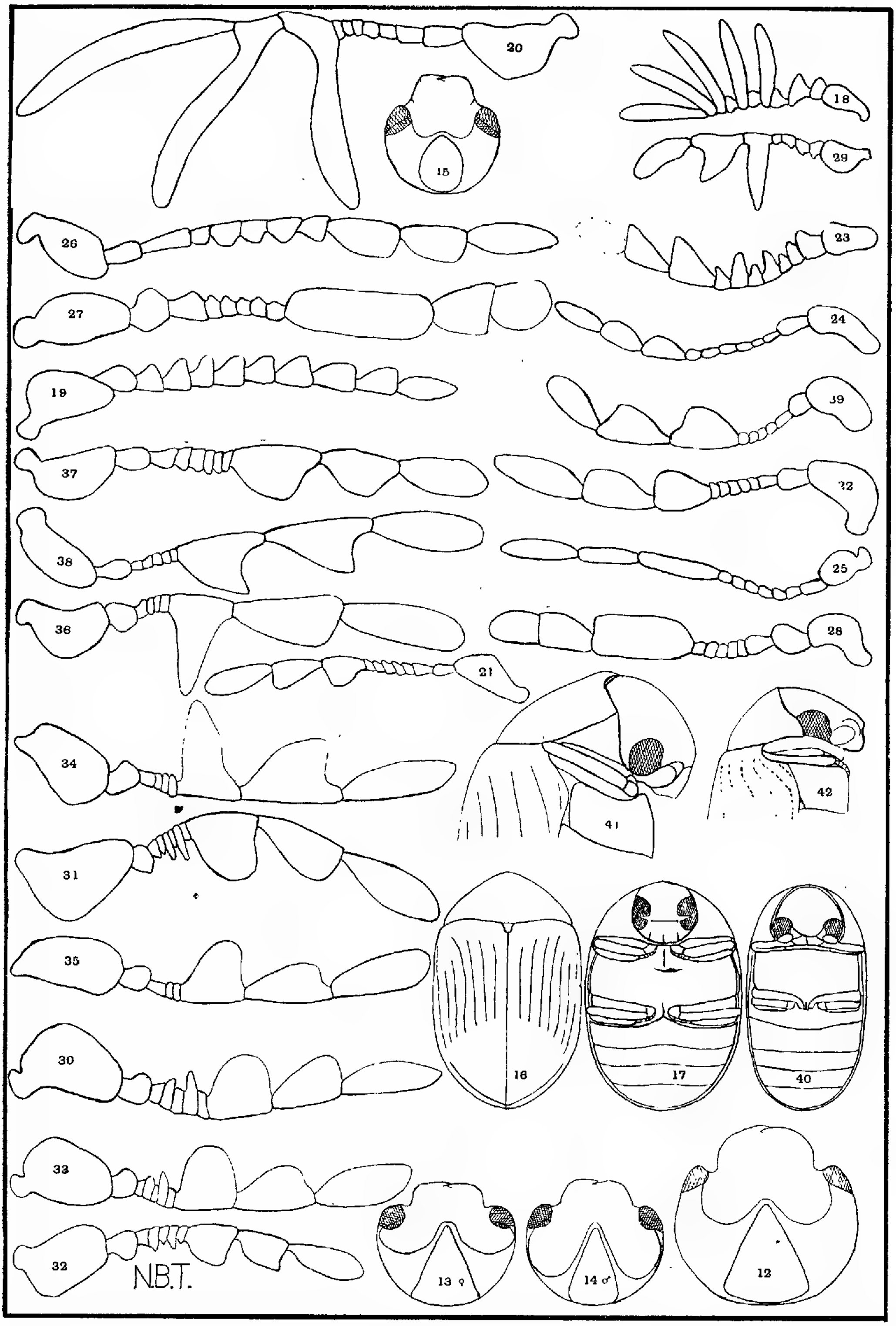


Fig. 1, Pattern of elytral marking of *Dryophilodes insignis,* Blackb.; 2, of *D. pyrifer,* Lea; 3, of *D. sagittifer,* Lea; 4, prothorax of *D. acuticollis,* Lea, as viewed from in front; 5, from behind; 6, *D. seriatus,* Lea, from in front; 7, from behind; 8, *D. marginicollis,* Lea, from in front; 9, from behind; 10, *D. cribripennis,* Lea, from in front; 11, from behind; 12, under surface of head of *Lasioderma serricorne,* Fab.; 13 and 14, of *Aulacanobium lanigerum,* Oll.; 15, of *Deltocryptus punctiventris,* Lea; 16 and 17, of *Dorcatoma irrasa,* Lea; 18, antenna of *Deroptilinus granicollis,* Lea; 19, of *Secretipes xanthorrhoeae,* Lea; 20, of *Aulacanobium lanigerum,* Oll.; 21, of *Dicoelocephalus granipennis,* Lea; 22, of *D. obscurus,* Macl.; 23, of *Deltocryptus punctiventris,* Lea; 24, of *D. inamoenus,* Lea; 25, of *Anobium areolicolle,* Lea; 26, of *Pronus subhumeralis,* Lea; 27, of *Calymmaderus pulverulens,* Lea; 28, of *C. inconspicuus,* Lea; 29, of *Caenocara insignicornis,* Lea; 30, of *Dorcatoma intreroculeris,* Lea; 31, of *D. irrasa,* Lea; 32, of *D. tasmaniensis,* Lea; 33, of *D. modica,* Lea; 34, of *D. antennalis,* Lea; 35, of *D. punctipennis,* Lea; 36, of *D. subcircularis,* Lea; 37, of *D. punctilatera,* Lea; 38, of *D. rhizobioides,* Lea; 39, of *D. elliptica,* Lea; 40, under surface of *Secretipes xanthorrhoeae,* Lea; 41, side view of *Dicoelocephalus granipennis,* Lea; 42, of *Deltocryptus punctiventris,* Lea.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prothorax, almost parallel-sided to beyond the middle; punctures crowded and nowhere lineate in arrangement. Length, 3·25-4·25 mm.

Hab.—South Australia: Adelaide (A. H. Elston and J. G. O. Tepper), Mount Lofty (Tepper); Western Australia: Geraldton (A. M. Lea).

A robust and rather dingy species, with outlines much as on the preceding one, but differently clothed; the elytra are more densely pubescent or maculate about the base, middle, and near apex than elsewhere, and have the appearance as of being irregularly abraded, but as they are alike on the seven specimens before me (including two taken quite recently) this appearance is evidently natural. On several specimens the abdomen and metasternum are no darker than the elytra, but the metasternum is usually somewhat darker; on one Adelaide specimen the sterna and abdomen are entirely black, and the prothorax, except in front, is rather deeply infuscated; the specimen from Geraldton is similar to the Adelaide one mentioned, except that it is smaller, and that the head is also infuscated.

Dryophilodes serricornis, n. sp.

Black; abdomen and posterior, three-fourths of elytra obscurely diluted with red; antennae, palpi, and tarsi reddish. Clothed with short, depressed, blackish pubescence, becoming somewhat longer and paler on abdomen.

Eyes prominent but not very large. Antennae not very long, second and third joints small, fourth to tenth serrated, eleventh slightly longer than tenth. Prothorax about once and two-thirds as wide as long, sides distinctly margined, base with a deeply impressed line but interrupted in middle, median line feeble but traceable throughout; punctures crowded and small. Elytra no wider than prothorax, parallel-sided to near apex; with crowded and small punctures, nowhere lineate in arrangement, but becoming rather coarse near base. Metasternum with median line from apex to base. Abdomen large, second and fifth segments slightly longer than the others. Length, 4 mm.

Hab.—Queensland: Mount Tambourine (A. M. Lea).

From some directions the elytra and abdomen appear to be entirely black. The distinctly serrated antennae and comparatively wide prothoracic margins are at variance with most species of the genus, but it does not appear desirable to propose a new genus for the reception of the single specimen taken.

Dryophilodes basicollis, n. sp.

Black; elytra and abdomen sometimes obscurely diluted with red; antennae, palpi, and parts of legs somewhat reddish. Clothed with short depressed pubescence, becoming conspicuously whitish across basal third of prothorax.

Eyes small and prominent. Antennae moderately long, first and eleventh joints longer than the others, these not much longer than wide. Prothorax moderately transverse, sides rather strongly rounded in front, and distinctly arcuate towards base, hind angles acute, median line not traceable; punctures crowded and small. Elytra no wider than widest part of prothorax, parallel-sided to near apex; with crowded punctures, nowhere distinctly seriate in arrangement. Apical segment of abdomen with a median depression, on each side of which is a small protuberance. Length, 2·25-2·75 mm.

Hab.—South Australia: Poonindie (Rev. T. Blackburn), Quorn (A. H. Elston), Ardrossan (J. G. O. Tepper), Murray Bridge; Tasmania: Mount Wellington (A. M. Lea).

On specimens in good condition the white pubescence is conspicuous across the entire base of prothorax, but it is comparatively easily disarranged; in some lights the elytra appear to have a median fascia of white pubescence, but it is never sharply defined, and varies with the point of view. On two specimens the derm of the elytra is entirely black, but on the others its apical two-thirds,

or less, is obscurely diluted with red; the abdomen also varies from entirely black to obscurely reddish. The Murray Bridge specimen has distinctly longer antennae than the others, and the apical segment of its abdomen is simple; the differences are probably sexual.

Dryophilodes pilipennis, n. sp.

Blackish-brown; head, under surface, antennae, palpi, and legs more or less obscurely reddish. Rather densely clothed with stramineous pubescence, longer on elytra than elsewhere, and converging to form lines.

Eyes prominent and rather large. Antennae moderately long and rather thin. Prothorax moderately transverse, sides, as viewed from above, strongly rounded in front, and strongly arcuate towards base, hind angles acute; with crowded punctures. Elytra parallel-sided to near apex; with dense and rather sharply defined punctures, of which some rather larger ones are formed into numerous distinct series. Length, 3·5 mm.

Hab.—South Australia: Lucindale (B. A. Feuerheerdt).

The lineate arrangement of the elytral pubescence and punctures is quite distinct. From behind there appears to be a faint but distinct Y on the prothorax, as the view is altered to a more forward one the Y alters to a V; but many other species appear to have similar Y's and V's.

Dryophilodes bifoveiventris, n. sp.

Deep black and subopaque; parts of antennae, of abdomen, and of legs obscurely diluted with red, palpi flavous. With short depressed pubescence, dark on the upper surface, pale on the under surface.

Antennae not very long, first and eleventh joints moderately long, the others not at all, or scarcely, longer than wide. Prothorax moderately transverse, sides strongly rounded in front and arcuate towards base, hind angles acute; punctures as on head. Elytra no wider than widest part of prothorax, parallel-sided to near apex, with a shallow longitudinal depression in middle of each; punctures crowded and nowhere distinctly lineate in arrangement. Abdomen with a large, round, shining fovea on each side of the apical segment. Length, 3·5 mm.

Hab.—Victoria: Birchip (J. C. Goudie, No. 300).

The abdominal foveae may be confined to one sex, but the species is otherwise distinct by its deep-black colour, and by the longitudinal depressions on the elytra. At first glance the hind angles of the prothorax appear to be rounded off, but they are really small and acute.

Dryophilodes orthodoxus, n. sp.

Dark brown or piceous-brown; antennae, palpi, and usually the abdomen, paler. Moderately clothed with pale pubescence.

Eyes small and very prominent. Antennae not very long. Prothorax moderately transverse, sides as viewed from above somewhat angulate in middle and arcuate towards base, hind angles acute, a finely impressed line at median base; punctures slightly larger than on head. Elytra at base no wider than prothorax, almost parallel-sided to near apex; with crowded punctures, larger towards base than elsewhere. Length, 1·75-2 mm.

Hab.—New South Wales: Galston (D. Dumbrell), Sydney, Tamworth, Dalmorton (A. M. Lea).

Structurally close to *D. murinus*, but smaller, less densely clothed, and prothorax with the usual finely impressed line across the median base; *D. parvoniger* is narrower, and with the sides of prothorax different, in addition to

being darker. In some lights the punctures about the shoulders appear to be obsoletely seriate in arrangement, and the interstices there to be granulate instead of punctate.

Dryophilodes metasternalis, n. sp.

Dull castaneous-brown; metasternum, and sometimes the abdomen, darker. Moderately clothed with pale depressed pubescence, usually denser in hind angles of prothorax.

Eyes prominent but rather small. Antennae moderately long. Prothorax moderately transverse, sides, as viewed from above, rather suddenly deflected from middle to apex, somewhat arcuate towards base, hind angles somewhat acute. Elytra slightly wider than prothorax, parallel-sided to near apex; with crowded and small punctures, nowhere distinctly seriate in arrangement. Length, 1·75-2·5 mm.

Hab.—South Australia: Tumby Bay (Rev. T. Blackburn), Parachilna (H. M. Hale), Lucindale (B. A. Feuerheerdt); New South Wales; Wollongong, Sydney (A. M. Lea); Queensland: Dalby (Mrs. F. H. Hobler).

The metasternum is usually darker than the abdomen and is sometimes almost black, as is occasionally the base of the abdomen. From some directions the pronotum appears to have a small median elevation near the base; the punctures on the basal third of elytra are larger than elsewhere, and from some directions cause the surface to appear granulate.

Dryophilodes murinus, n. sp.

Dark piceous-brown or blackish; antennae, legs, and sometimes the abdomen, obscurely reddish. Densely clothed with short, depressed, pale (but not white) pubescence, denser on basal half of median line, on hind angles of prothorax, and on scutellum than elsewhere.

Eyes small and prominent. Antennae thin, but not very long. Prothorax moderately transverse, sides, as viewed from above, somewhat produced in middle and distinctly arcuate towards base, hind angles acute; punctures crowded and normally almost concealed. Elytra at base slightly wider than prothorax, not quite parallel-sided to near apex; with crowded and rather small punctures, nowhere distinctly seriate in arrangement, and larger on and about shoulders than elsewhere. Length, 2-2·5 mm.

Hab.—Tasmania: Huon River; New South Wales: Sydney (A. M. Lea).

Structurally fairly close to the preceding species, but slightly more robust, darker, and with denser clothing. From some directions a subtriangular space on each shoulder appears less shining than the rest of the elytra, but this is mostly due to the larger punctures there. The absence of a finely impressed line across the median base of the pronotum is rare in the genus. The specimen from Sydney has the legs black and the pubescence of the upper surface somewhat looser, but the latter feature may be due to accident.

Dryophilodes acuticollis, n. sp. Figs. 4, 5.

Black, opaque; antennae, legs, and abdomen dull reddish, palpi paler. With very short pale pubescence, denser on hind angles of prothorax and on scutellum than elsewhere.

Eyes small and very prominent. Antennae rather long and thin. Prothorax scarcely wider at base than the median length; sides, as viewed from above, acutely produced in middle, and distinctly arcuate to base, with the hind angles acute, a faint ridge along middle; punctures as on head. Elytra conspicuously wider than base of prothorax, parallel-sided to near apex; with crowded punctures, nowhere seriate in arrangement, but somewhat larger about

shoulders than elsewhere. Abdomen with a medio-apical impression, on each side of which is a small acute prominence. Length, 2·75-3 mm.

Hab.—Tasmania: Hobart (A. M. Lea).

The type appears to be a male. A second specimen, from Hobart, is probably a female, as its abdomen is simple, it is smaller than the type, the elytra vaguely diluted with red posteriorly, and the metasternum no darker than the abdomen. A specimen from Forest Reefs (New South Wales) appears to be another female of the species, but has the under surface black. The prothorax of all the specimens, when viewed from above, or from behind the scutellum, appears to have the sides acute or even spinose in the middle, but from a frontal view the sides appear rounded from the middle to the apex.

Dryophilodes parvoniger, n. sp.

Deep black; antennae, palpi, and legs reddish. Clothed with short, depressed, ashen pubescence.

Eyes small and prominent. Antennae rather short, only the first and eleventh joints conspicuously longer than wide. Prothorax moderately transverse, sides rounded in middle and arcuate towards base, hind angles somewhat acute; punctures slightly larger than on head. Elytra very little wider than widest part of prothorax, parallel-sided to near apex; with crowded punctures, near base obscurely lineate in arrangement and larger than elsewhere. Length, 2 mm.

Hab.—New South Wales: Galston (A. M. Lea).

A small, comparatively narrow, black species; in some lights the abdomen appears obscurely reddish.

Dryophilodes brunneipennis, n. sp.

Black; elytra dingy brown; antennae, palpi, and legs paler. With depressed pale pubescence.

Eyes small and prominent. Antennae not very long. Prothorax not much wider than long; sides, as viewed from above, somewhat prominent in middle, distinctly arcuate towards base, hind angles acute; punctures slightly coarser than on head. Elytra slightly wider than widest part of prothorax, parallel-sided to near apex; with dense punctures, somewhat asperate and larger on basal half than elsewhere, and more or less lineate in arrangement, except on parts of the apical slope. Length, 2·25-3 mm.

Hab.—South Australia: Lucindale (B. A. Feuerheerdt), Mount Lofty (A. H. Elston and J. G. O. Tepper); Western Australia: Geraldton (A. M. Lea); Tasmania: Mount Wellington (Lea).

The apex of the prothorax is usually narrowly reddish, the abdomen is sometimes as black as the metasternum, but is often obscurely reddish, the femora are somewhat infuscated in the middle; on several specimens the sides below the shoulders are slightly infuscated. A vague median line may mostly be traced on the apical half of the pronotum, and sometimes a vague oblique impression on each side of the middle near base. The lineate arrangement of the elytral punctures is distinct from many directions, but from some points of view the shoulders appear to be covered with small crowded granules. The specimen from Geraldton is rather thinner, and has slightly longer antennae and pubescence than usual.

Dryophilodes apicipennis, n. sp.

Black; antennae, palpi, and parts of legs reddish, elytra more or less reddish about apex. With short, depressed, pale pubescence.

Eyes small and very prominent. Antennae moderately long, none of the joints transverse. Prothorax moderately transverse, sides prominent in middle,

arcuate towards base, hind angles acute, median line fairly distinct, a feeble oblique impression on each side of middle towards base; punctures larger than on head. Elytra slightly wider than widest part of prothorax, parallel-sided to near apex; with fairly large asperate punctures, in rows about basal half and on sides, becoming smaller and irregular posteriorly. Length, 2-2·5 mm.

Hab.—South Australia: Mount Lofty (S. H. Curnow, A. H. Elston, and J. G. O. Tepper).

Structurally rather close to the preceding species, but elytra deep black except posteriorly, where on two specimens they are obscurely diluted with red, and on two others distinctly reddish.

Dryophilodes eucalypti, n. sp.

Black, opaque; abdomen and tarsi obscurely reddish, palpi paler, elytra obscurely diluted with red posteriorly. Moderately clothed with short, depressed, dingy pubescence.

Eyes prominent and moderately large. Antennae rather long, all the joints distinctly longer than wide. Prothorax very little wider at base than the median length; sides, as viewed from above, acute in middle and arcuate to base, hind angles acute and overhanging elytra; with crowded, but fairly sharply defined punctures. Elytra scarcely wider than widest part of prothorax, parallel-sided to near apex; with close-set rows of asperate punctures, becoming smaller, more crowded and irregular posteriorly. Length, 3·5-4·25 mm.

Hab.—Victoria: Seaford, numerous specimens reared from eucalyptus galls (J. F. Dixon), Birchip (J. C. Goudie).

On several specimens the abdomen is almost as black as the metasternum; the antennae are entirely black, or with only the apical joints obscurely reddish. From some directions there appears to be a feeble pubescent Y on the pronotum; seen directly from above the scutellum, or from a more posterior point, the sides of the prothorax appear to be acutely produced, but from in front they are seen to be quite evenly rounded on the apical half.

Dryophilodes acutangulus, n. sp.

Black, in parts subopaque; elytra obscurely diluted with red posteriorly, antennae, palpi, legs, and abdomen dull reddish, sterna somewhat darker. Clothed with short, depressed, pale pubescence.

Eyes small and very prominent. Antennae moderately long, a few of the joints scarcely longer than wide. Prothorax moderately transverse; sides, as viewed from above, rather acutely produced in middle, strongly arcuate to base, hind angles acute; punctures slightly larger than on head, appearing like small granules from some directions. Elytra comparatively short, no wider than widest part of prothorax, parallel-sided to near apex; with crowded and small punctures; in addition, except posteriorly, with rows of fairly large asperate ones. Length, 3·5 mm.

Hab.—New South Wales: Forest Reefs (A. M. Lea).

The head and prothorax are about as large as on the preceding species, but the elytra, although of the same width, are distinctly shorter, as a result the species is wider in proportion; the hind angles of the prothorax are quite as acute as on that species, but they are produced outwards, instead of slightly overhanging the elytra.

Dryophilodes brevicollis, n. sp.

Dull brown and subopaque; antennae, palpi, and legs paler. Moderately clothed with short, depressed, pale pubescence.

Head more convex in middle than usual. Eyes of moderate size and very prominent. Antennae not very long, but all the joints, except the second, longer than wide. Prothorax almost twice as wide as long, sides strongly rounded in front, arcuate towards base, hind angles acute and slightly overhanging elytra, median line fairly distinct; punctures crowded and small. Elytra comparatively short, distinctly wider than prothorax, almost parallel-sided to near apex; with fairly regular rows of asperate punctures, the rows almost vanishing posteriorly, the interstices everywhere with small crowded punctures. Length, 3 mm.

Hab.—South Australia: Lucindale (B. A. Feuerheerdt).

A rather wide species, structurally fairly close to *D. acutangulus*, but differently coloured. Two specimens from New South Wales (Forest Reefs and Armidale, A. M. Lea) probably belong to the species, but have most of the pronotum deeply infuscated, almost black, and the elytra also deeply infuscated, except on the sides (very narrowly) and along the suture.

Dryophilodes subhumeralis, n. sp.

Dull piceous-brown; legs, abdomen, and hind parts of elytra more reddish; with short, depressed, and mostly pale pubescence.

Eyes small and very prominent. Antennae rather long and thin, none of the joints transverse. Prothorax at base scarcely wider than the median length; sides, as viewed from above, acutely angulate in middle and arcuate to base, hind angles acute; median line faint in front, slightly raised posteriorly; punctures as crowded as on head but slightly larger. Elytra distinctly wider than prothorax, parallel-sided to near apex; with crowded punctures, becoming larger and with a granulate appearance about base, about and for a short distance behind shoulders somewhat seriately arranged. Length, 2-2·5 mm.

Hab.—South Australia: Karoonda to Peebinga (G. E. H. Wright), Quorn (A. H. Elston), Lucindale (A. M. Lea).

From some directions there appears to be a distinct dark-velvety patch on the side near each shoulder, but this disappears when the side is viewed at a right angle. Although referred to C, *ff*, in the table, the seriate arrangement of the elytral punctures is rather faint.

Dryophilodes rufobrunneus, n. sp.

Dull reddish-brown; moderately clothed with short stramineous pubescence.

Eyes prominent and comparatively large. Antennae moderately long and thin. Prothorax at base very little wider than the median length; sides, as viewed from above, acute in middle and rather strongly arcuate to base, a vague oblique depression on each side of middle towards base; densely granulate-punctate. Elytra comparatively narrow, but distinctly wider than prothorax, parallel-sided to near apex; with closely placed series of asperate punctures to well beyond the middle, with crowded and small punctures all over. Length, 3-3·25 mm.

Hab.—South Australia: Lipson's Cove, under bark; New South Wales: Werris Creek (Rev. T. Blackburn).

From most points of view the prothorax and elytra appear to be closely covered with small granules. The Werris Creek specimen is slightly larger and darker than two from Lipson's Cove, but otherwise is in close agreement with them.

Dryophilodes seriatus, n. sp. Figs. 6, 7.

Dull reddish-brown; abdomen and legs somewhat paler; with very short pale pubescence.

Eyes small and prominent. Antennae not very long, several of the joints very little longer than wide. Prothorax at base not much wider than the median length; sides, as viewed from above, acutely produced in middle and arcuate to base, a shallow oblique depression on each side of middle near base; densely granulate-punctate. Elytra rather thin, much wider than base of prothorax, parallel-sided to near apex; with close-set rows of subquadrate punctures, becoming smaller posteriorly but traceable almost to apex; interstices with small punctures. Length, 3 mm.

Hab.—Tasmania: Hobart (A. M. Lea).

In general appearance rather close to the preceding species, but slightly narrower, elytra with seriate punctures less asperate, traceable close to the apex itself, and the interstices with minute punctures, nowhere causing them to appear granulate. From some directions the hind angles of the prothorax appear to be more than 90 degs., but from a perpendicular point of view they are seen to be less.

Dryophilodes flavipalpis, n. sp.

Dull castaneous-brown; abdomen and legs paler, palpi flavous. Rather densely clothed with short pale pubescence, denser on hind angles of prothorax than elsewhere.

Eyes small and prominent. Antennae not very long, some of the joints scarcely, if at all, longer than wide. Prothorax at base not much wider than the median length, sides strongly rounded in middle and arcuate to base, hind angles acute and slightly overlapping elytra; punctures crowded but partially concealed. Elytra not much wider than widest part of prothorax, parallel-sided to near apex; with dense and minute punctures, and fairly distinct rows of larger ones, disappearing posteriorly. Length, 2·5-3 mm.

Hab.—South Australia: Murray Bridge (Rev. T. Blackburn), Barossa (A. H. Elston), Ooldea (A. M. Lea); Western Australia: Swan River (Lea).

The seriate punctures on the elytra are distinct from most directions, they are rather stronger towards the sides than suture.

Dryophilodes interstitialis, n. sp.

Colour and clothing as described in preceding species.

Head as in preceding species. Prothorax moderately transverse, sides angulate but not apparently spinose in middle, somewhat arcuate to base, hind angles acute; punctures crowded and with a granulated appearance. Elytra not much wider than widest part of prothorax; with close-set rows of rather large asperate punctures, the rows disappearing posteriorly, the surface generally with a distinctly granulated appearance. Length, 2·25-2·5 mm.

Hab.—Western Australia: Mount Barker (R. Helms), Swan River (A. M. Lea).

In general appearance decidedly close to the preceding species, but slightly more robust, and seriate punctures of elytra somewhat larger and more asperate, and the interstices between them with a distinctly granulated appearance, that is wanting in that species.

Dryophilodes pulverulentus, n. sp.

Dull castaneous-brown; abdomen, legs, and hind parts of elytra somewhat paler, palpi flavous. Clothed with extremely short pubescence, almost dust-like on the elytra.

Eyes of moderate size and very prominent. Antennae moderately long, most of the joints scarcely or not at all longer than wide. Prothorax with outlines as in preceding species, but with somewhat smaller punctures. Elytra with

outlines as in preceding species, but punctures and interstices as on *D. flavipalpis.* Length, 2·25-2·75 mm.

Hab.—South Australia: Tumby Bay (Rev. T. Blackburn), Lucindale (A. M. Lea); New South Wales: Queanbeyan (Lea).

Structurally and in general appearance very close to the two preceding species, but the characters noted in the table are sufficiently distinctive when specimens of each are placed side by side. The general outlines are nearer those of *D. interstitialis,* than those of *D. flavipalpis,* but the elytral punctures of *D. interstitialis* are decidedly coarser than on either of the others.

Dryophilodes melanostethus, n. sp.

Dull reddish-castaneous; metasternum black. Rather densely clothed with short pale pubescence, denser on hind angles of prothorax and on scutellum than elsewhere.

Eyes rather small and very prominent. Antennae not very long, second to fourth joints scarcely longer than wide. Prothorax moderately transverse, sides not very strongly rounded in middle and somewhat arcuate to base, hind angles acute; punctures crowded and (except at apex) slightly larger than on head. Elytra at base scarcely wider than widest part of prothorax, sides not quite parallel to near apex; with close-set rows of fairly large asperate punctures, becoming smaller posteriorly, surface generally with small punctures, but between the rows with a granulated appearance. Length, 2-3 mm.

Hab.—South Australia: Adelaide (J. G. O. Tepper), Quorn (A. H. Elston), Murray Bridge (A. M. Lea); New South Wales: Sydney, reared from coccid galls (W. W. Froggatt), Tamworth (Lea).

In general appearance close to *D. metasternalis,* but elytra with distinct series of punctures. The basal segment of the abdomen is usually black, and occasionally the whole abdomen is dark, although hardly as black as the metasternum. Two of the South Australian specimens are decidedly below the average size, and have a suggestion of the subhumeral velvety patches of *D. subhumeralis,* from which they are at once distinguished by the sides of the prothorax. The pubescence on the hind parts of the elytra, of the South Australian specimens, in some lights, has a distinct golden-red gloss. The New South Wales specimens have a darker and duller appearance than the others, and their pubescence is slightly longer and denser, but otherwise they agree well with typical ones.

Dryophilodes subcylindricus, n. sp.

Black, palpi and parts of legs reddish. Pubescence extremely short, pale, and depressed.

Eyes small and prominent. Antennae rather long and thin, second and third joints smaller than the others. Prothorax about one-fourth wider than long, strongly and evenly convex, except for a slight medio-basal elevation, sides strongly and evenly rounded, hind angles obtuse; punctures as on head. Elytra parallel-sided to near apex, slightly narrower than widest part of prothorax; with crowded and small, non-seriate punctures. Length, 2-2·5 mm.

Hab.—South Australia: Mount Lofty Ranges, Myponga, Barossa (A. H. Elston), Karoonda to Peebinga (G. E. H. Wright), Parachilna (E. L. Savage), Lucindale (B. A. Feuerheerdt), Port Lincoln (Rev. T. Blackburn and A. M. Lea), Gawler (Lea); Tasmania: Huon River, Mount Wellington, Hobart (Lea).

A narrow, subcylindrical, black species, appearing greyish on account of its minute pubescence. The tarsi and usually the tibiae are reddish, but the latter are sometimes almost as dark as the femora; the antennae are usually blackish, but are occasionally obscurely reddish, rarely the abdomen is obscurely diluted

with red. The antennae vary somewhat in length, and the median joints of the male are stouter than those of the female. Three specimens, from Quorn (A. H. Elston), probably belong to this species, but have the apical half of elytra and the antennae obscurely reddish, and the tibiae and tarsi of a brighter red than usual.

Should it be eventually decided to split up the genus this species and *D. vigilans*, *D. angustus*, and *D. minor* should be associated together, although now separated by the exigencies of the table.

var. **brunneus**, n. var.

Nine specimens from South Australia—Myponga and Quorn (A. H. Elston), Lucindale (B. A. Feuerheerdt), Oodnadatta (Rev. T. Blackburn), and Mount Gambier (A. M. Lea)—appear to belong to this species, but differ from the others in being of a more or less dingy brown, with the sterna (and on two specimens the head) black.

Dryophilodes fumosus, n. sp.

Dull dark brown, sterna darker. Closely covered with short ashen pubescence, appearing almost white on scutellum.

Eyes not very large but very prominent. Antennae moderately long and thin. Prothorax moderately transverse, sides strongly rounded in middle, where the width is slightly more than that of elytra, hind angles slightly more than right angles; punctures much as on head. Elytra parallel-sided to near apex; with crowded and small punctures, but towards base and sides with obscure series of larger ones. Length, 3 mm.

Hab.—Northern Queensland (Blackburn's collection).

A subcylindrical, dingy-brown species; although distinct from all other species before me, its position in the table is somewhat doubtful, as, from some directions, a lineate arrangement of punctures is traceable towards the base of elytra, and it is rather narrower than the other species referred to *yy*.

Dryophilodes robustus, n. sp.

Dull reddish-brown; sterna almost black. Densely clothed with more or less golden pubescence, becoming whitish on under surface and on scutellum.

Eyes small and prominent. Antennae moderately long and thin. Prothorax not much wider than long, sides strongly rounded in middle and somewhat arcuate to base, hind angles slightly more than 90 degs., punctures larger than on head. Elytra slightly wider than prothorax, not thrice as long as wide, parallel-sided to near apex; with small crowded punctures. Length, 2·75-3·25 mm.

Hab.—South Australia (A. H. Elston), Parachilna (E. L. Savage); New South Wales: Gosford (A. M. Lea).

A rather robust species, with elytral pubescence from some directions appearing of a beautiful golden-red; the pubescence at the base of the prothorax is scarcely as white as on the scutellum, although it is paler than on the rest of the upper surface. The punctures of the upper surface are usually concealed by the clothing, but where this has been abraded they are seen to be more sharply defined than is usual in the genus.

Dryophilodes niger, n. sp.

Black; legs and muzzle reddish, apical slope of elytra and tip of abdomen obscurely reddish. With short, depressed, whitish pubescence, denser on scutellum and on hind angles of prothorax than elsewhere.

Eyes small and very prominent. Antennae moderately long. Prothorax about once and one-half as wide as long, sides strongly rounded, hind angles obtuse; punctures somewhat larger than on head. Elytra rather robust, the width of base of prothorax, parallel-sided to near apex; with crowded punctures, nowhere seriate in arrangement, but larger towards base than posteriorly. Length, 2-2·25 mm.

Hab.—South Australia: Ooldea (A. M. Lea).

A short black species, with somewhat silvery clothing. On the type the legs are distinctly reddish, on a second specimen they are almost black; the antennae of both specimens appear to be black, but on close examination some of the joints are seen to be obscurely brownish. From some directions the upper surface appears to be granulate, rather than punctate; this is especially noticeable on the sides of the prothorax.

Dryophilodes pullatus, n. sp.

Black; apex of elytra, abdomen, antennae, palpi, and parts of legs more or less obscurely reddish. Rather densely clothed with dingy ashen pubescence, having a rather loose appearance on upper surface.

Eyes rather small and very prominent. Antennae rather thin. Prothorax moderately transverse, sides strongly rounded, hind angles apparently rounded off; punctures crowded and slightly larger than on head. Elytra the width of widest part of prothorax, parallel-sided to near apex; with rather dense punctures, becoming smaller posteriorly. Length, 3·5 mm.

Hab.—Tasmania: Kelso (Aug. Simson).

A black subcylindrical species, in general appearance strikingly close to several species of *Dasytes*, of the Malacodermidae. The hind angles of the prothorax are small, but from most directions they appear to be completely rounded off; the elytral punctures are larger and sparser on the sides near the shoulders than elsewhere, and from some directions they appear to be lineate in arrangement, but from above the lineate arrangement is nowhere evident. The metasternum is more shining than is usual in the genus.

Dryophilodes albatus, n. sp.

Dull reddish-brown; palpi and abdomen usually paler. Densely clothed with white pubescence.

Eyes small and prominent. Antennae moderately long. Prothorax moderately transverse, sides somewhat rounded in middle and oblique to base, hind angles slightly overlapping elytra and slightly more than 90 degs.; punctures crowded and normally concealed. Elytra slightly wider than prothorax, parallel-sided to near apex; with crowded punctures, the basal half or two-thirds in addition with series of larger ones. Length, 2·75-3·25 mm.

Hab.—South Australia: Myponga (A. H. Elston), Kangaroo Island (J. G. O. Tepper), Lucindale (B. A. Feuerheerdt), Mount Gambier (A. M. Lea); Victoria: Cheltenham, in November (F. E. Wilson); Tasmania: Kelso, Karoola, Georgetown, Beaconsfield (Aug. Simson), Huon River, Ulverstone, Hobart (Lea), Strahan (H. J. Carter and Lea); New South Wales: National Park, Sydney (Lea).

Some of the specimens are darker than usual (almost piceous-brown), but the pubescence appears to be always whitish. There are seriate punctures on at least the basal half of elytra, but it is usually necessary to partly abrade the pubescence to be sure of this.

Dryophilodes multiseriatus, n. sp.

Black; elytra, palpi, legs, and basal half of antennae of a more or less dingy brown; with short, pale, inconspicuous pubescence.

Eyes rather large and very prominent. Antennae comparatively short. Prothorax moderately transverse; sides, as viewed from above, subacutely produced in middle, hind angles obtuse, each side of middle with two shallow impressions, an oblique one and a transverse one, meeting in middle of base; punctures slightly larger than on head. Elytra wider than prothorax, parallel-sided to near apex; with close-set rows of fairly large punctures, terminated just before the apical slope, on which all the punctures are minute. Length, 2-2·5 mm.

Hab.—South Australia: Port Lincoln (Rev. T. Blackburn), Ooldea (A. M. Lea).

The impressions on the pronotum and the seriate punctures on the elytra are more conspicuous than usual. One specimen, probably immature, is of a dingy brown, with the elytra and legs almost flavous.

Dryophilodes latipennis, n. sp.

Black; elytra, antennae, and legs of a dingy reddish-brown, palpi paler. Moderately clothed with short ashen pubescence.

Eyes small and prominent. Antennae rather short, only the first and eleventh joints distinctly longer than wide. Prothorax distinctly transverse, sides moderately rounded, hind angles more than 90 degs., median line fairly distinct; punctures slightly larger than on head. Elytra slightly wider than prothorax, scarcely twice as long as wide, sides almost parallel to near apex; with crowded and small punctures, and, in addition, with rather inconspicuous series of larger ones on basal two-thirds. Length, 2·5-3·75 mm.

Hab.—Western Australia: Swan River, Darling Ranges, Bridgetown (A. M. Lea).

With the robust form of *D. latus*, but elytral pubescence uniform throughout, although sometimes denser on scutellum and on hind angles of prothorax than elsewhere. The front edge of the prothorax is usually obscurely reddish.

Dryophilodes brevicornis, n. sp.

Black; elytra, abdomen, antennae, and legs of a more or less dingy reddish-brown, palpi paler. Moderately clothed with short ashen pubescence.

Eyes small and prominent. Antennae rather short, most of the joints wider than long. Prothorax moderately transverse; sides, as viewed from above, somewhat acutely produced in middle, hind angles more than 90 degs.; punctures slightly larger than on head. Elytra slightly wider than widest part of prothorax, parallel-sided to near apex; with small crowded punctures, the basal two-thirds with inconspicuous rows of larger ones. Length, 2·5 mm.

Hab.—South Australia: Port Lincoln (A. M. Lea).

At first sight very near *D. brunneipennis*, but antennae somewhat shorter and prothorax more convex in middle, with its hind angles more than 90 degs.

Dryophilodes marginicollis, n. sp. Figs. 8, 9.

Dull dark brown; abdomen and palpi paler. Clothed with short ashen pubescence.

Eyes of moderate size and very prominent. Antennae not very long. Prothorax moderately transverse, strongly convex, sides distinctly margined from base to apex; densely granulate-punctate. Elytra slightly wider than prothorax, parallel-sided to near apex; with crowded and small punctures, and in addition with larger seriate ones, distinct above base and shoulders, but vanishing on apical third. Length, 3 mm.

Hab.—North-western Australia: Fortescue River (W. D. Dodd).

The prothoracic margins are somewhat as in *D. serricornis*, but the antennae are normal. From some directions the hind angles of the prothorax appear to be acute, but from others to be obtuse or even rounded off. On the type the elytra are somewhat paler on the apical slope than elsewhere, and each side near the shoulder, from some directions, appears to have a dark velvety patch, but this disappears when viewed at a right angle.

Dryophilodes ubiquitosus, n. sp.

Dull dark brown; abdomen and palpi paler. Densely clothed with rather short ashen pubescence, denser and paler on scutellum, and on hind angles of prothorax than elsewhere.

Eyes fairly large and very prominent. Antennae not very long. Prothorax about once and two-thirds as wide as long; sides, as viewed from above, subacutely produced in middle, hind angles obtuse, median line faintly impressed in front; punctures slightly larger than on head. Elytra scarcely wider than widest part of prothorax, parallel-sided to near apex; with crowded and small punctures, and close-set series of larger ones, distinct on basal half but vanishing posteriorly. Length, 2·5-3 mm.

Hab.—South Australia: Adelaide, Barossa (A. H. Elston), Mount Lofty (S. H. Curnow), Lucindale (B. A. Feuerheerdt and F. Secker), Tumby Bay (Rev. T. Blackburn), Kangaroo Island (J. G. O. Tepper and A. M. Lea); Victoria: Alps (Blackburn), Birchip (J. C. Goudie); New South Wales (Blackburn), Forest Reefs, Galston, Sydney (Lea); Northern Queensland (Blackburn's collection).

A fairly robust, dingy species; one of the specimens from New South Wales is almost black. The clothing on the hind angles of the prothorax is not perhaps actually paler than elsewhere, but from most directions it appears to be so, probably from its greater density.

Dryophilodes obscuripennis, n. sp.

Black; antennae, palpi, and legs (the femora sometimes excepted) of a dingy reddish, elytra obscurely diluted with red posteriorly. Moderately clothed with dingy ashen pubescence.

Eyes rather small and very prominent. Antennae moderately long. Prothorax almost twice as wide as long; sides, as viewed from above, evenly rounded in middle, hind angles slightly more than 90 degs., median line faintly traceable from base to apex; punctures much as on head. Elytra slightly wider than prothorax, parallel-sided to near apex; with dense and small punctures, in addition with close-set series of fairly large ones, well defined on basal third, but vanishing before apical slope. Length, 2·25-3 mm.

Hab.—New South Wales: Galston (D. Dumbrell and A. M. Lea).

A rather robust species, structurally close to *D. latipennis*. The base of the elytra appears to be always as dark as the prothorax, but the hind parts are more or less obscurely paler; from some directions the derm about the shoulders appears to be covered with small granules.

Dryophilodes abjectus, n. sp.

Dull castaneous-brown; with short pale pubescence.

Eyes rather small and prominent. Antennae fairly long and rather thin. Prothorax about once and two-thirds as wide as long; sides, as viewed from above, rather sharply angulate in middle, hind angles more than 90 degs.; closely granulate-punctate. Elytra scarcely wider than widest part of prothorax, parallel-sided to near apex; with crowded and small punctures, about base with

series of larger ones, but the series scarcely traceable to middle, except on sides. Length, 1·75 mm.

Hab.—South Australia: Port Lincoln (Rev. T. Blackburn).

A small dingy species. The palpi and legs are paler than the other parts but not very conspicuously so.

A specimen from Tasmania (Karoola, Aug. Simson) possibly belongs to this species, but its prothorax is less transverse, and the elytral punctures are larger and more asperate, with the lineate arrangement of the larger ones traceable almost to the apical slope.

Dryophilodes subapicalis, n. sp.

Dull, dark castaneous-brown; with short, depressed, pale pubescence.

Eyes of moderate size and very prominent. Antennae rather long and thin, all the joints, except the second, longer than wide. Prothorax strongly transverse, sides strongly rounded, hind angles obtuse; punctures crowded and small. Elytra elongate, scarcely wider than widest part of prothorax, parallel-sided to near apex; densely granulate-punctate, in addition with close-set rows of asperate punctures, distinct to well beyond the middle, and on the sides almost to apex. Length, 3·75-4·5 mm.

Hab.—Western Australia: Swan River (A. M. Lea).

A comparatively large subcylindrical species. On the apical slope of elytra there appears to be a large and fairly distinct reddish spot, narrowly traversed by the dark suture; the suture, in fact, is very narrowly blackish throughout, but is only conspicuously so where it traverses the paler portion; on the larger of two specimens the abdomen is somewhat paler than the metasternum. From some directions the pubescence on the upper surface has a reddish gloss. The hind angles of the prothorax are about 120 degs., but from some directions they appear to be rounded off. From most points of view the elytral interstices appear to be distinctly granulate rather than punctate, whilst the shoulders and about the base seem roughly granulate.

Dryophilodes vigilans, n. sp.

Black, some parts opaque; palpi, tibiae, and tarsi reddish; with extremely short, dingy, depressed pubescence.

Eyes rather large and very prominent. Antennae rather long and thin, median joints stouter, second smallest. Prothorax moderately transverse, sides strongly and evenly rounded; punctures as on head. Elytra long, thin and parallel-sided, slightly narrower than widest part of prothorax; with dense and minute punctures, and with series of larger ones, fairly distinct on the basal half, but vanishing posteriorly. Length, 2·5-3·25 mm.

Hab.—New South Wales: Forest Reefs (A. M. Lea).

A thin black species, structurally close to *D. subcylindricus*, but consistently larger, eyes larger and elytral punctures seriate in arrangement on the basal half, although the arrangement is indistinct from most directions. In the male the tip of the abdomen is slightly notched, and the eyes are larger than in the female. The antennae are usually of a dingy reddish-brown, with the basal joint darker, the tips of the abdominal segments are usually reddish, occasionally the entire abdomen is obscurely diluted with red. The median base of the pronotum, although not elevated above the front parts, is slightly elevated above the adjacent surface. Four specimens have the prothorax and elytra obscurely brownish, but are probably immature. A specimen from Mount Kosciusko (W. E. Raymond) probably belongs to the species, but has the elytra of a dark reddish-brown, except that a large subtriangular space about the scutellum, and the shoulders, are black.

Dryophilodes planicollis, n. sp.

Black; elytra, antennae, palpi, and legs (except femora) more or less reddish, abdomen obscurely reddish posteriorly. Clothed with ashen pubescence, with a rather loose appearance.

Eyes small and very prominent. Antennae rather long and thin, all the joints, except the second, longer than wide. Prothorax rather flat, not much wider than long, sides strongly rounded and very finely serrated, hind angles obtuse, median line faintly marked; punctures slightly larger than on head. Elytra rather thin, scarcely wider than widest part of prothorax, but conspicuously wider than its base, parallel-sided to near apex; with fairly dense punctures about base, but becoming comparatively sparse posteriorly. Length, 2·25 mm.

Hab.—Western Australia: Swan River (A. M. Lea).

The prothorax is flatter than usual, practically only the front sides sloping downwards, its hind angles also are almost rounded off, the minute serrations of the sides are somewhat obscured by the clothing. The elytral punctures are rather sharply defined, but are comparatively sparse posteriorly, and their lineate arrangement is feeble, even near the base.

Dryophilodes nigrinus, n. sp.

Black, some parts paler. Rather sparsely clothed with ashen pubescence.

Eyes of moderate size and very prominent. Antennae not very long, only the first and eleventh joints distinctly longer than wide. Prothorax moderately transverse, sides strongly rounded, the greatest width equal to that of elytra, hind angles obtuse; punctures small and crowded. Elytra rather thin, parallel-sided to near apex; with close-set rows of fairly large punctures, becoming smaller posteriorly, but distinct almost to apical slope. Length, 2-2·5 mm.

Hab.—South Australia: Port Lincoln (Rev. T. Blackburn), Mount Lofty (N. B. Tindale).

In general appearance much like *D. planicollis*, but the seriate arrangement of the elytral punctures is distinct to well beyond the middle. Five specimens are before me; of these four have the elytra black, with the hind parts more or less obscurely diluted with red, the other has the elytra of a dingy brown throughout; the antennae and legs are blackish, except that the tarsi are obscurely reddish; even the palpi are dark. The prothorax has several very vague discal impressions, and usually a shining but feeble median elevation near the base; the hind angles from some directions appear to be rounded off, from others each appears as a minute tooth. One specimen is distinctly wider than the others, but may represent a variety.

Dryophilodes politus, n. sp.

Black; apical parts of elytra and parts of legs, of antennae, and palpi more or less reddish. With sparse ashen pubescence.

Eyes rather small and very prominent. Antennae thin but not very wide. Prothorax scarcely wider than long, sides subacutely produced in middle, hind angles obtuse; punctures crowded and somewhat coarser than on head, but becoming very small on a shining space at middle of apex, and on a shining median line, the latter abruptly terminated near base. Elytra shining, conspicuously wider than widest part of prothorax, and much wider than its base, parallel-sided to near apex; with close-set rows of fairly large punctures, disappearing posteriorly, where the surface is minutely punctate. Length, 1·75-2 mm.

Hab.—South Australia: Mount Lofty (S. H. Curnow); Western Australia: Swan River (A. M. Lea).

This species has the general appearance as of the New Zealand genus *Sphinditeles (Mesanobium* of Sharp), and it may be desirable eventually to refer it to that genus. On the type the apical slope of elytra (except that the suture is very narrowly dark) is of a rather bright reddish-flavous; on the Swan River specimen the apical slope is but obscurely diluted with red, on each of them the apical half of the antennae is blackish. Owing to the sparsity of pubescence the punctures are more sharply defined than usual.

Dryophilodes subopacus, n. sp.

Black, subopaque; tarsi, knees, and coxae reddish, apical slope of elytra obscurely diluted with red. Moderately clothed with short ashen pubescence.

Eyes fairly large and very prominent. Antennae moderately long, but only the first and eleventh joints distinctly longer than wide. Prothorax not much wider than long, sides strongly rounded in middle (from some directions appearing subacute there); median line somewhat shining and fairly distinct near base; punctures crowded and small. Elytra wider than widest part of prothorax, and much wider than its base, parallel-sided to near apex; with crowded and small punctures or finely shagreened, in addition with close-set rows of fairly large asperate punctures, distinct to well beyond the middle, and on the sides almost to apex. Length, 2 mm.

Hab.—New South Wales: National Park (A. M. Lea).

A narrow dingy species, but with parts of the under surface shining; the elytra at first appear to be as black as the prothorax, but when closely examined are seen to be obscurely paler. Partly owing to the clothing most parts of the upper surface appear to be minutely granulate. Structurally it is rather close to the preceding species, but is duller, more densely clothed, and the prothorax and eyes are larger.

Dryophilodes minor, n. sp.

Piceous or blackish, legs and abdomen more or less reddish. Rather densely clothed with pale pubescence, having a rather loose appearance.

Head with crowded, partially concealed, punctures. Eyes small and very prominent. Antennae rather long and thin. Prothorax moderately transverse, sides strongly rounded and slightly wider than elytra, hind angles obtuse; with small crowded punctures. Elytra rather thin, parallel-sided to near apex; with crowded and small punctures, the basal half with obscure series of larger ones. Length, 1·75-2 mm.

Hab.—Tasmania: Huon River (A. M. Lea).

A small, narrow, dingy species, whose specimens have the general appearance as of females of *Cis.* The prothorax usually appears to be blackish, with the apex rather widely reddish, or sometimes with both base and apex reddish; on some specimens the derm of the elytra appears blackish, but it is usually of a dingy brown; the metasternum is usually darker than the abdomen, and the apical half of the antennae is darker than the basal half.

Dryophilodes cribripennis, n. sp. Figs. 10, 11.

Dull reddish-brown; abdomen and parts of legs somewhat paler. Moderately clothed with rather short pale pubescence, denser on scutellum and on hind angles of prothorax than elsewhere.

Eyes small and prominent. Antennae moderately long, most of the joints longer than wide. Prothorax moderately transverse, sides, as viewed obliquely from behind, apparently acutely produced at basal third, but oblique to base.

hind angles obtuse; median line faint but distinct from some directions; punctures crowded and slightly larger than on head. Elytra rather narrow but much wider than base of prothorax, parallel-sided to near apex; with dense and small but rather sharply defined punctures, and in addition with close-set rows of larger asperate ones, becoming smaller posteriorly, but distinct to summit of apical slope and on the sides to apex. Length, 2 mm.

Hab.—New South Wales: Gosford (A. M. Lea).

A small dingy species, with median line of prothorax traceable from base to apex from some directions, but invisible from others. As on many others of the genus, parts of the derm appear minutely granulate through the clothing.

Dryophilodes parvicollis, n. sp.

Dull reddish-brown; palpi paler. Moderately clothed with pale pubescence, denser on scutellum and on base of prothorax than elsewhere.

Eyes small but very prominent. Antennae rather long and thin. Prothorax not much wider than long, sides strongly rounded in middle, from some directions appearing angulate, hind angles obtuse; median line not traceable; punctures crowded and small, becoming minute at middle of apex. Elytra rather thin, conspicuously wider than widest part of prothorax; with crowded minute punctures, and in addition with close-set rows of fairly large ones, traceable to summit of apical slope, and on the sides to near apex. Length, 2-2·5 mm.

Hab.—Western Australia: Albany (Blackburn's collection and R. Helms), Geraldton (A. M. Lea); Queensland: Mount Tambourine (Lea).

In general appearance close to the preceding species, but prothorax smaller, sides, as viewed from behind, less acutely angulate, without a median line, antennae somewhat longer, and the small punctures of elytra less sharply defined. The Queensland specimen is slightly smaller, and has slightly larger eyes than the others, but there appears to be nothing to warrant its specific separation.

Dryophilodes pallidus, n. sp.

Pale castaneous, upper surface feebly shining, under surface brighter. Clothed with short pale pubescence.

Eyes small and prominent. Antennae rather long and thin. Prothorax moderately transverse, sides, as viewed from behind, rather acute in middle, hind angles slightly more than 90 degs.; punctures crowded and minute. Elytra rather thin, distinctly wider than widest part of prothorax, parallel-sided to near apex; with dense and minute punctures, and in addition with larger seriate ones, fairly distinct on basal third, but, except on sides, not traceable to middle. Length, 1·5 mm.

Hab.—Western Australia: Geraldton (A. M. Lea).

An unusually small pale species.

Ernobius mollis, Linn., Syst. Nat., x., 1758, p. 355.

This species can now be recorded as Australian, as specimens have been taken in New South Wales (Sydney) and Tasmania (Launceston). Seven synonyms and varieties are noted in Pic's recent catalogue of the family.

Lasioderma serricorne, Fab. Fig. 12.

Two specimens received from Mr. W. W. Froggatt are labelled as having been taken "in wax of wild bee" at Derby (North-western Australia); they are decidedly above the average size of the species, but I can find no other distinguishing feature.

Deroptilinus, n. gen.

Head concealed from above. Eyes small, round, entire, latero-frontal. Antennae inserted in front of eyes, and slightly inwards, basal joint rather large, second to fourth, sixth and eighth, more or less triangular, eleventh elongate, the others each with a long ramus. Prothorax finely margined throughout, front portion granulate. Scutellum moderately large. Elytra slightly narrowed posteriorly, not quite covering the abdomen. Prosternum reduced to a minimum in front, with concealed cavities for the reception of antennae. Mesosternum concealed, except for a very short intercoxal process. Metasternum elongate, episterna wide. Abdomen with five distinct segments, the basal one deeply grooved on each side for the reception of hind legs. All legs capable of being received in depressions, the femora grooved for reception of tibiae, tarsi with four basal joints short, produced on lower surface, fifth about as long as two preceding ones combined.

Apparently nearer *Ptilinus* than any other genus, but prosternum different in front, elytra not completely covering the abdomen, two basal joints of tarsi much shorter and antennae different. The intervention of small joints between the fifth, seventh, and ninth is alike on the four specimens before me, but the rami vary in length, probably with sex; on *Ptilinus* the antennae are strongly serrated in the female. The head when removed from the body is seen to have a narrow neck, with a ridge or fine groove along its middle.

Deroptilinus granicollis, n. sp. Fig. 18.

Black; shoulders and tips of elytra and legs obscurely reddish, basal joints of antennae and tarsi paler. Densely clothed with very short ashen pubescence, somewhat variegated on elytra.

Head densely granulate-punctate or shagreened. Antennae with apical joint and rami of fifth, seventh, ninth, and tenth distinctly longer than first. Prothorax moderately transverse, front strongly rounded and about half the width of base; densely and finely granulate, but apical half, except on sides, more coarsely granulate. Elytra scarcely more than twice the length of prothorax; with rather feeble striae, becoming still more feeble posteriorly but rather deep on the sides near shoulders; interstices with dense and rather small asperate punctures, and much denser and very minute ones. Metasternum with dense asperate punctures, median line narrow and rather deep. Length, 3·75-4·25 mm.

Hab.—Tasmania (H. H. D. Griffith).

The rather coarse granules on the front of the prothorax are as in many species of *Bostrychidae* and *Scolytidae*. There are punctures in the elytral striae, but partly owing to the density of the general punctures, and partly to the pubescence, they are not sharply defined. The description is that of a male, a specimen that accompanied it, and is probably a female, has the elytra and abdomen of a dingy brown, the shoulders paler than the rest of the elytra, and its antennae with the rami of the fifth and tenth joints no longer than the first joint. A specimen from King Island has the extreme margins of elytra (but not the shoulders) paler than the adjacent parts; its antennae are as in the second specimen. One from northern Queensland has the elytra and femora scarcely paler than the adjoining parts; with the apical joint of antennae and the rami somewhat longer and darker than on the type. On the elytra of the type pale pubescence is conspicuous on the basal fourth, narrowly continued along the suture, and suddenly dilated to form a diamond-shaped patch about the summit of the apical slope, on the rest of the elytra the pubescence is brownish; on the second Tasmanian specimen the pale patches are traceable but less sharply defined; on the others the elytral clothing is almost uniformly brown.

Trypopitys multimaculatus, n. sp.

Castaneous-brown or piceous-brown; antennae, palpi, and tarsi paler. Densely clothed with ashen and whitish pubescence, conspicuously maculate or mottled on upper surface.

Head rather small, punctures crowded but normally concealed. Eyes rather small but prominent. Antennae rather short, first joint rather large, second small, third and fourth still smaller, fifth to tenth larger and somewhat serrated, eleventh slightly larger than tenth. Prothorax slightly wider than long, strongly gibbous along middle, sides strongly produced downwards; with crowded partially concealed punctures. Elytra thin, parallel-sided to near apex; with regular rows of large punctures, becoming smaller posteriorly, interstices feebly separately convex, with small and minute punctures. Pectoral canal deep, connected with a narrow, deep, median line on posterior two-thirds of metasternum. Basal segment of abdomen about two-thirds the length of second, all with curved sutures. Legs thin and moderately long. Length, 4-6 mm.

Hab.—Tasmania (Aug. Simson), Launceston, Hobart; New South Wales: Forest Reefs (A. M. Lea).

The two shades of pubescence are irregularly intermingled on the pronotum, but on the elytra the paler kind forms numerous irregular spots, in places sometimes conjoined to form short oblique fasciae, the clothing on the scutellum is usually conspicuously whitish. On some specimens the elytral punctures are considerably larger than on others, being decidedly wider than the interstices on the basal half; such specimens are usually smaller and darker than the others, and are probably males.

This and the two following species have a deep and conspicuous notch at the median front of the metasternum, continuing the pectoral canal as in *Anobium*, but the three apical joints of the antennae do not form a large loosely-compacted club, and the ninth and tenth are practically the same as the preceding joints, the eleventh being only a little longer; hence they have been referred to *Trypopitys*, now first recorded as Australian. On each of them, on each side of the prothorax, there is a rather acute ridge that is directed obliquely downwards and forwards, but terminates half-way from the apex; it is more or less obscured by the clothing and legs, and is invisible from above.

Trypopitys pictipennis, n. sp.

Castaneous-brown; most of elytra darker, antennae and palpi paler. Densely clothed with pale brown, or somewhat ochreous pubescence, irregularly mottled with black on elytra; on under surface becoming greyish-white.

Head with crowded but mostly concealed punctures. Eyes large and prominent. Antennae with first joint rather large, second and third small, fourth to tenth strongly serrated, eleventh slightly longer than tenth and first. Prothorax slightly wider than long, strongly gibbous in middle, sides strongly produced downwards, an acute prominence in each hind angle; punctures rather coarse and partially concealed. Elytra thin and parallel-sided to near apex; with regular rows of large deep punctures, becoming smaller (but still large) posteriorly. Basal segment of abdomen about half the length of the following one, all with curved sutures. Length, 4·75 mm.

Hab.—New South Wales: Dorrigo (W. Heron).

Rather close to the preceding species, but more brightly coloured, pectoral canal longer, eyes decidedly larger, and antennae more conspicuously serrated; of the latter the fourth to tenth joints are all distinctly triangular, the fourth is wider than long, the intervening joints gradually altering to the tenth, which is longer than wide; the pectoral canal is continuous from apex of prosternum

to apex of metasternum, but about the middle of the latter it is traversed by a narrow shining ridge, behind which it rapidly narrows to its end. On the basal third of elytra the pubescence is mostly black, on the apical two-thirds it irregularly covers about half of the derm.

Trypopitys uniformis, n. sp.

Pale castaneous; antennae and palpi paler. Densely clothed with short, pale, depressed pubescence, interspersed with short sloping setae.

Head with crowded, partially concealed, punctures. Eyes prominent and of moderate size. Antennae with basal joint large, second and third small, fourth to tenth somewhat obtusely serrated, eleventh about once and one-half the length of tenth, and about the length of first, but distinctly thinner. Prothorax slightly wider than long, strongly gibbous in middle, irregularly depressed near base, sides strongly produced downwards; with crowded and rather small, partially concealed, punctures. Elytra thin and parallel-sided to near apex; with regular rows of rather large and deep punctures, becoming smaller posteriorly; interstices gently separately convex, but more strongly convex on sides; with crowded, small, and minute punctures. Abdomen large, basal segment as long as third and about one-third shorter than second, all with curved sutures. Legs thin but not very long. Length, 6 mm.

Hab. -Tasmania: Hobart (A. M. Lea).

In general appearance close to large specimens of *Anobium domesticum*, but with the antennae of *Trypopitys*. The uniformly coloured pubescence of the upper surface at once distinguishes from the two preceding species; the posterior end of the pectoral canal is also different, the canal is deep between the front and middle legs, but behind the latter it slopes at an angle of 45 degs., and is rather obscure on its sides, a narrow depression along its middle connects with a narrow, deep, median line on the apical half of the metasternum.

Tasmanobium, n. gen.

Head concealed from above. Eyes rather large, prominent, and with small facets. Antennae serrated, non-clavate. Prothorax transverse, pronotum separated from each side of prosternum by an acute ridge. Scutellum distinct. Elytra narrow, parallel-sided, striation regular. Prosternum with a wide shallow groove in front for partial reception of head; flanks large, each produced to a point in front; metasternum elongate, side pieces large. Abdomen large. Legs rather long and thin, front coxae projecting and in contact, middle ones almost in contact, hind ones separated by a narrow intercoxal process; femora moderately grooved for reception of tibiae; basal joint of tarsi about as long as three following combined.

The three specimens of this genus before me in general appearance are strikingly close to *Anobium domesticum* and *Trypopitys uniformis*, but the absence of a pectoral canal, and the front coxae in contact, exclude it from both *Anobium* and *Trypopitys;* from the latter genus it is also excluded by the acute marginal ridges of the prothorax, and from the former also by the serrated antennae. By the table of Lacordaire it would be associated with *Trypopitys*, but in his diagnosis of that genus, as also of *Anobium*, the under surface (except of the head) is not even mentioned. By Leconte and Horn's table of the subgroup Anobia it would be associated with *Sitodrepa*, but in that genus each antenna has a large three-jointed club. In my table it is associated with *Secretipes*, with which it has little in common.

Tasmanobium mimicum, n. sp.

Pale castaneous; antennae and palpi paler. Moderately densely clothed with minute pale pubescence.

Head comparatively large; with dense minute punctures. Antennae with first joint moderately large, second small, third to tenth somewhat obtusely serrated, eleventh about once and one-half the length of tenth and first. Prothorax moderately transverse, rather strongly convex but not gibbous in middle, sides rather strongly rounded near base, which is twice the width of apex, a large and somewhat angular depression on each side of base, and a transverse one on each side of apex; punctures partially concealed but apparently larger than on head. Elytra thin, no wider than greatest width of prothorax; with rows of rather large punctures, becoming smaller posteriorly and larger on sides; interstices feebly convex and minutely punctate or shagreened. Metasternum with a narrow, deep, median line. Abdomen with basal segment in middle quite as long as second, the latter slightly longer than third or fifth, fourth slightly shorter than these, all with straight sutures. Length, 5-6 mm.

Hab.—Tasmania: Hobart, Strahan (A. M. Lea).

There is a longitudinal carina at the base of the head, but to see it clearly the head must be detached from the prothorax.

Secretipes, n. gen.

Head entirely concealed from above, its under surface transversely impressed between eyes. Mandibles short and stout, when at rest touching middle coxae. Eyes moderately large, lateral, and rather coarsely faceted. Antennae moderately long, eleven-jointed, basal joint stout, apical one slightly longer and thinner than tenth, the others somewhat serrated. Palpi small, apical joint securiform. Prothorax strongly convex, sides triangularly produced downwards and immarginate. Scutellum semicircular. Elytra with striae confined to sides. Prosternum and mesosternum very short and normally concealed; metasternum elongate, narrowly grooved along middle, middle of apex with two processes between hind coxae; side pieces narrow at base, subtriangular posteriorly. Abdomen with basal segment rather short but distinct from side to side, second as large as third and fourth combined, fifth about half as long again as fourth. Legs rather small, the front ones smallest of all, and normally entirely concealed, their coxae in contact; middle legs received in lateral cavities, their tarsi received in shallow grooves, which are continued behind a median process of the mesosternum; hind legs received in abdominal depressions, the coxae touching elytra, trochanters rather large.

This genus quite evidently belongs to the Xyletini, but appears to be excluded from *Xyletinus* itself, and from all other described genera of that group by the following characters in combination:—Front legs entirely concealed with head at rest; hind legs retractile into abdominal excavations; antennae serrated, the three apical joints neither greatly elongated nor clavate; elytral striae confined to sides. The species have the general appearance of those of *Deltocryptus*, the smaller ones of *Pronus*, and the more elongated ones of *Dorcatoma;* but all of these have a large three-jointed club. Owing to the intervention of the processes of the metasternum between the hind coxae the abdomen appears to be without an intercoxal process. Type of genus, *S. xanthorrhoeae*.

Secretipes xanthorrhoeae, n. sp. Figs. 19, 40.

Of a more or less dingy brown, parts of legs paler, antennae and palpi flavous. Densely clothed with minute pale pubescence.

Densely and minutely punctate all over. Elytra with two moderate striae on each side, curving around apex, but only one almost touching suture.

Metasternum with median line somewhat dilated in middle but shallow there. Length, 2·5-3·5 mm.

Hab.—South Australia: Parachilna (E. L. Savage), Port Lincoln, Adelaide (Rev. T. Blackburn), Mount Lofty Ranges, taken by means of sweep net (A. M. Lea), Kangaroo Island (J. G. Otto Tepper), Lucindale (B. A. Feuerheerdt); Western Australia: Swan River, Donnybrook (Lea).

Some specimens have the upper surface almost castaneous-brown, on others it is mostly piceous-brown or even blackish, but with the sides obscurely paler; the metasternum is sometimes darker than the abdomen. Although only two striae are fairly distinct on each side, a third is faintly indicated in parts. Most of the specimens were taken from the dry flowering stems of species of *Xanthorrhoea.*

Secretipes latericollis, n. sp.

Dark castaneous-brown or piceous-brown; antennae, palpi, and tarsi paler; metasternum usually slightly darker than abdomen. Densely clothed with minute pale pubescence.

With dense and minute punctures, but larger and more distinct on metasternum and flanks of prothorax than elsewhere. Length, 2·5-2·75 mm.

Hab.—Queensland: Dalby (Mrs. F. H. Hobler), Townsville; New South Wales: Tamworth, Forest Reefs (A. M. Lea).

In general appearance close to the preceding species, and with similar elytral striae, except that they are somewhat deeper, but metasternum and flanks of prothorax with decidedly coarser punctures, the antennae are thinner, the basal joint is smaller, and the second larger in proportion.

Seven specimens from northern Queensland (Blackburn's collection) probably belong to this species, but are somewhat smaller (2-2·25 mm.) and thinner, and another from Dalby is still smaller.

Aulacanobium, n. gen.

Head concealed from above, under surface deeply bisinuate for reception of antennae. Eyes moderately large and with rather large facets. Antennae with basal joint large, the following seven small, the three apical ones forming a large club, of which the first and second joints each have a long ramus (longer in male than in female). Prothorax transverse, sides triangularly produced downwards. Scutellum distinct. Elytra strongly striated. Prosternum with triangular vertical flanks. Mesosternum normally concealed. Metasternum with a deep median groove. Abdomen with five segments, but only the intercoxal process of the first visible. Legs rather short and received in cavities, the front pair thinner than the others, with their coxae pressed backwards and touching.

Although the type of this genus was described by Olliff as a *Dorcatoma*, its antennae are very different from those of that genus, and are received in two deep sinuations on the under surface of the head (much as in *Lasioderma serricorne*), the front coxae are in contact (instead of widely separated), and there is no cavity in the breast behind them, so that instead of belonging to the Dorcatomides it really belongs to Xyletinides, and should be placed near *Lasioderma.*

Aulacanobium lanigerum, Oll. *(Dorcatoma).* Figs. 13, 14, 20.

The type of this genus was evidently described from a contracted specimen; it is some years since I examined it, but there are now before me specimens that were compared and agreed with it. The antennae were originally described as "reddish-testaceous," but this only applies to the parts normally visible; the club is composed of three black joints, of which the first and second each have a long ramus (longer in the male than in the female). There are nine striae on

each elytron, and they are much stronger than on any other described Australian species of the subfamily. Two specimens were marked as taken from a fungus by Mr. W. W. Froggatt.

Dicoelocephalus, n. gen.

Head concealed from above, base of under surface deeply bisinuate and hollowed for reception of antennae. Eyes small. Antennae eleven-jointed, basal joint large, three apical ones forming a large loosely-compacted club. Prothorax bisinuate at base. Scutellum distinct. Elytra closely applied to prothorax, striate-punctate, or seriate-punctate. Prosternum with triangular flanks, base conjointly excavated with mesosternum on each side, for reception of front and middle legs; middle normally concealed by head; with an inner channel on each side for reception of side of head. Mesosternum concealed, except for intercoxal process. Metasternum deeply grooved in middle. Abdomen with first segment entirely concealed by hind legs, except for a small intercoxal process, the three following segments large, with their sutures bisinuate, the apical one longer. Legs received into excavations; front coxae pressed backwards, their tips in contact, middle coxae widely separated, the hind ones less widely separated but extending to the sides of abdomen, hind femora partly received in coxal grooves, each knee received in a notch on the side of an elytron, tibiae received in femora; tarsi short, hind and middle ones each received in a narrow groove near the trochanter.

With the head at rest the mandibles are in contact with the middle coxae, entirely concealing the front ones, so that, except for the more conspicuous rows of elytral punctures, there is nothing to distinguish the species from *Dorcatoma;* but on removing the head the front coxae are seen to be in contact, and there is no sternal cavity for the reception of the antennae, these being received in deep sinuations on the under surface of the head, much as on *Lasioderma serricorne.* From above the hind angles of the prothorax appear to be acute and to embrace the sides of elytra, but from the sides they are seen to be rounded off and to be more than right angles. The genus occurs also in New Zealand, as Mr. A. E. Brookes has an unnamed species of it from Okauia. Type of genus, *D. granipennis.*

Dicoelocephalus granipennis, n. sp. Figs. 21, 41.

Black, subopaque; parts of under surface and of legs obscurely paler; antennae reddish; with very short, depressed, pale pubescence.

Head with dense and small punctures; a thin curved carina from near each eye to clypeal suture, but not meeting there, a feeble median carina at base. Antennae with basal joint large, second small but longer than wide, third somewhat smaller, fourth to eighth transverse, first and second joints of club large, subequal, wider and shorter than apical joint. Prothorax twice as wide at base as at apex, sides finely margined; with small crowded punctures. Elytra with small punctures in shallow striae, both becoming deeper on sides, interstices with dense and minute granules, denser on shoulders than elsewhere. Metasternum with moderately large punctures, median line closed at mesosternum, but open posteriorly. Apical segment of abdomen twice as long as the subapical one. Length, 4·5-5·25 mm.

Hab.—Western Australia: King George's Sound (G. Masters), Donnybrook (A. M. Lea).

An oblong-elliptic, strongly convex species, the pale pubescence on the black background gives the upper surface a mouse-coloured appearance; in parts it is somewhat wavy. The head and prothorax from some directions appear densely and finely granulate, but on the upper surface the only true granules are on the elytra, there they are very small, but being somewhat shining they are very

distinct in certain lights. On several specimens a faint median line may be traced on the prothorax. From the side the notch on each elytron for the hind knee is very distinct, the notch for the middle knee is larger but less abrupt.

Dicoelocephalus decipiens, n. sp.

Of a dark dingy brown and somewhat shining; under surface of head and antennae, except basal joint, paler; with rather dense, depressed, ashen pubescence.

Head with dense and small but sharply defined punctures. Antennae with basal joint and three joints of club large, the intervening joints small. Prothorax with dense and small punctures. Elytra parallel-sided to near apex; densely and finely punctate or shagreened, striation distinct on sides, but somewhat obscure elsewhere. Prosternum with triangular flanks exposed; metasternum apparently divided into two median parts by the tarsal grooves of the middle legs, with a deep and rather wide median line, in parts densely punctate and opaque, elsewhere shining. Abdomen apparently composed of four segments, owing to the true basal one being concealed by the hind legs, except for a small intercoxal process. Length, 2·25 mm.

Hab.—New South Wales: Galston (A. M. Lea).

An oblong-elliptic species, much smaller than the preceding or the following ones but with the under surface of head deeply bisinuate, the lateral triangles of prosternum exposed and with similar abdomen and front legs. The middle parts of the sterna are evidently as in the following species, but the type being unique I have not dissected out the front and middle legs to examine the concealed parts. The elytral striae are traceable at regular intervals from suture to sides, but they appear as feeble undulations of a shagreened surface rather than defined lines containing distinct punctures; on the basal half of each side, however, there are three rather well-defined rows of rather large rugose punctures, the outer row beyond the middle appears more as a simple stria, and curves around the apex almost to touch the suture.

Dicoelocephalus obscurus, Macl. *(Cryptorhopalum)*. Fig. 22.

This species was referred to *Cryptorhopalum*, of the Dermestidae, with expressed doubts; it certainly belongs to the Anobiides, and probably to *Dicoelocephalus*, with the type species of which it agrees in all essential generic features, notably in the bisinuate under surface of head, in the antennae, and the abdomen. Some specimens before me were compared and agreed with the type, although they were not then dissected. It is considerably smaller than *D. granipennis*, somewhat narrower, seriate punctures of elytra less conspicuous, without granules, and metasternum different. When the sternae are clearly visible the middle of the mesosternum appears to be fairly long (about half the length of the metasternum) and rapidly narrowed to disappear between the front and middle legs, its hind margin being defined by the tarsal grooves, but this appearance is deceptive, as the part really belongs to the metasternum; when the head is removed the mesosternum is exposed, and its middle appears as a small process scarcely larger than the second joint of antennae. The rows of punctures on the sutural two-thirds of elytra are rather faint, but appear more distinct owing to the pubescence; on the sides they are distinct on the basal half, but posteriorly become faint, except that the outer row is curved around the apex so as almost to touch the suture.

Hab.—Queensland: Gayndah (type), Dalby, Cairns; New South Wales: Illawarra, Forest Reefs.

Deltocryptus, n. gen.

Pronotum with sides produced downwards; prosternum normally entirely concealed, in the middle by the head, at the sides by the legs. Abdomen with basal segment concealed at sides by the legs, but with a fairly large triangular intercoxal process; sutures of the three following segments incurved to middle. Other characters as described in *Dicoelocephalus.*

This genus is certainly close to *Dicoelocephalus*, agreeing with it in the under surface of the head, antennae, concealed parts of legs, etc., but on that genus the pronotum is defined from the prosternum by an acute dividing line, between which and the front legs there is a well-defined triangle on each side; on the present genus the sides of the pronotum are brought downwards so that the dividing line between it and each side of the prosternum is in contact with the front legs, the triangle on each side being absent or rather entirely concealed; seen from each side there appears to be a triangular extension of the pronotum interposed between the front leg and eye for some distance, but for these to be in partial contact; on *Dicoelocephalus* the eye touches the exposed triangle of the prosternum, which completely separates it from the legs. Most of the species have the general appearance as of belonging to *Dorcatoma*, and unset specimens cannot readily be distinguished from that genus, but on detaching the head its under surface may be seen to be deeply bisinuate for the reception of the antennae (the head of at least one specimen of every species here described has been examined to make sure of this) and that the front coxae are in contact. Type of genus, *D. punctiventris.*

TABLE OF SPECIES OF DELTOCRYPTUS.

A. Abdomen with long pubescence partly obscuring its sutures .. .. *ursus*
AA. Abdomen with sutures well defined.
B. Sutural half of elytra without distinct rows of punctures.
a. Under surface pale .. .. *inamoenus*
aa. Metasternum black .. .. *funereus*
BB. Sutural half of elytra with rows of large, or at least distinct punctures.
C. Pubescence extremely short and inconspicuous .. .. .. *xyleboroides*
CC. Pubescence mixed with longer hairs.
D. Median line of metasternum wide .. .. *aulacostethus*
DD. Median line of metasternum narrow in middle.
E. Length, 2 mm. or more .. .. *punctiventris*
EE. Length, 1½ mm. or less .. .. *microscopicus*

NOTE ON TABLE.

The longer hairs are usually inconspicuous, especially on *D. aulacostethus*, unless the insect is viewed from the sides; but on *D. xyleboroides* the pubescence itself is so short as to be almost dust-like.

Deltocryptus punctiventris, n. sp. Figs. 15, 23, 42.

Dark brown and slightly shining; under parts of head and antennae paler. Rather densely clothed with pale depressed pubescence, interspersed with numerous suberect hairs or setae.

Head with dense and small punctures. Antennae with basal joint and three joints of club large. Prothorax with punctures much as on head. Elytra with crowded and small punctures, and with regular rows of larger ones, becoming small posteriorly, the sides with rows of larger subquadrate punctures, the outer one curving around apex so as almost to touch the suture. Metasternum with crowded but sharply defined punctures, median line narrow and deep. Abdomen with dense punctures; basal segment distinct in middle and very narrowly traceable to sides. Length, 2-2·5 mm.

Hab.—Tasmania: Hobart (H. H. D. Griffith and A. M. Lea), Waratah, in moss (H. J. Carter and Lea), Launceston (Aug. Simson); Victoria: Dividing Range (Rev. T. Blackburn); New South Wales: National Park, in rotting leaves, Forest Reefs (Lea).

The hairs among the pubescence are more conspicuous on some specimens than on others. The head has a feeble median carina at the base, but it is sometimes concealed. On this, as on all others of the genus, the middle of the mesosternum is represented by a small (almost pointed) shining process, concealed with the head at rest, but distinct after it has been removed. On all of them the eyes are rather small.

Deltocryptus ursus, n. sp.

Dark brown; antennae and tarsi paler. Densely clothed with rather long, depressed, pale pubescence, and with some suberect hairs scattered about.

Head with dense and small punctures. Antennae with basal joint and three joints of club large, apical joint almost as wide and distinctly longer than either of the preceding ones. Prothorax with punctures as on head, but less distinct on account of clothing. Elytra with dense and minute punctures, and with rows of larger ones, becoming conspicuous on sides. Metasternum with dense but rather sharp punctures; median line deep and narrow, but somewhat wider and open posteriorly. Length, 2·5 mm.

Hab.—Tasmania: Hobart (A. M. Lea).

An oblong-elliptic species structurally rather close to the preceding one, but more densely clothed; the pubescence is longer and more conspicuous than on all the others here described, and on the upper surface of the type it is somewhat waved, but this may be accidental; on the abdomen it is almost as long as on the upper surface, and obscures the sutures from most directions. The seriate punctures on the elytra are obscured by the clothing, so that it is difficult to trace a row throughout its length; but on each side there are three rows of larger ones that are rather conspicuous on the basal half, of these the outer one only curves around the apex so as almost to reach the suture. There is a concealed pectoral cavity, but it is for the reception of the tips of the mandibles, not for the antennae (as in *Dorcatoma*), these being received in the bisinuations on the under surface of the head; the front coxae (normally concealed) are also pressed backwards, with their tips touching.

Deltocryptus aulacostethus, n. sp.

Blackish; head, elytra, and legs obscurely paler; tarsi and antennae much paler (almost flavous). With rather dense, depressed, ashen pubescence, interspersed with a few hairs.

Head with dense and small punctures. Basal joint of antennae and three joints of club large. Prothorax with punctures as on head, but less distinct on account of clothing. Elytra parallel-sided to near apex; with dense and small punctures, and with conspicuous rows of somewhat angular ones, becoming smaller posteriorly, but even there distinct. Under surface with dense and small punctures; median line of metasternum deep and wide. Length, 2 mm.

Hab.—New South Wales: Tamworth (A. M. Lea).

The seriate punctures on the sides of elytra are unusually large, so that they are distinctly wider than the interstices, even near the suture they are almost as wide as the interstices. With the head removed the median elevation of the mesosternum is quite conspicuous when viewed along the wide median line of the metasternum.

Deltocryptus microscopicus, n. sp.

Dark brown and somewhat shining; antennae and tarsi paler, metasternum almost black. With short, depressed, and not very dense, ashen pubescence, interspersed with suberect hairs.

Head with dense and small but rather sharp punctures. Antennae with basal joint and three joints of club large. Prothorax with base almost straight; punctures much as on head. Elytra widest near base, nowhere parallel-sided, with dense and small punctures, and with rows of rather large angular punctures, becoming larger and rougher on sides. Under surface with dense and small but rather distinct punctures; median line of metasternum deep and narrow. Length, 1-1·25 mm.

Hab.—New South Wales: Sydney, National Park, in rotting leaves (A. M. Lea).

A minute, elliptic-ovate species, at first apparently belonging to *Dorcatoma*, but with under surface of head deeply bisinuate for the reception of antennae, front coxae in contact, and median process of mesosternum quite distinct from behind, when the head has been removed.

Deltocryptus xyleboroides, n. sp.

Of a dingy castaneous-brown and subopaque, sutures of elytra and of metasternum narrowly infuscated; antennae flavous; with very short and inconspicuous pubescence.

Head with crowded and small punctures, with a thin median carina becoming acute posteriorly. Antennae with basal joint and three apical joints of club large. Prothorax scarcely one-fourth wider than long; densely and minutely punctate, middle of apical half minutely granulate. Elytra long and parallel-sided to near apex, surface shagreened or minutely punctate, with regular rows of rather large but shallow asperate punctures, becoming deeper on sides. Metasternum with dense but fairly sharp punctures; median line deep and narrow. Length, 2·75 mm.

Hab.—Queensland: Bundaberg (A. M. Lea).

An elongate parallel-sided species, in general appearance unlike the others here described, but with the under surface of head deeply bisinuate for the reception of antennae, front coxae in contact, and other generic details in conformity with them. Seen directly from above it has a striking resemblance to small Scolytidae of the genus *Xyleborus*.

Deltocryptus inamoenus, n. sp. Fig. 24.

Castaneous, parts of prothorax and of elytra slightly infuscated, antennae flavous; with short, depressed, pale pubescence.

Head and prothorax with dense minute punctures. Antennae with basal joint and three joints of club large. Elytra with dense and minute punctures, with large seriate ones confined to sides. Metasternum more shining, slightly darker and with sparser punctures than abdomen, median line deep and narrow. Length, 2 mm.

Hab.—South Australia: Tarcoola (A. M. Lea).

On the type there is a large infuscation on the prothorax and elytra about the scutellum, but its outlines are not well defined and it may not be constant. The sutural half of each elytron is without traces of striation, but on each side there are three rows of somewhat angular punctures, of which the outer row changes to a stria and is curved around the apex so as almost to touch the suture.

Deltocryptus funereus, n. sp.

Black or blackish, legs obscurely paler, antennae flavous; with short, depressed, pale pubescence.

Head with dense and small but fairly distinct punctures, becoming smaller on prothorax. Antennae with basal joint and three joints of club large, each joint, except the first and eleventh, acutely produced on one side. Elytra with dense and small punctures, with distinct rows on sides, but elsewhere without distinct ones. Metasternum more shining than abdomen, slightly darker, and with a rather wide median line. Length, 2 mm. (vix).

Hab.—South Australia: Barton (A. M. Lea).

Fairly close to the preceding species but much darker, metasternum with a wider median line and antennae different. In preparing an antenna for mounting in Canada balsam, the apical joint was lost, but it was of large size.

Anobium areolicolle, n. sp. Fig. 25.

Of a dingy brown, under surface somewhat darker than upper, palpi and usually parts of the tarsi paler. Densely clothed with short brownish pubescence, partly depressed, and partly sloping.

Head with dense, small, and even granules. Eyes prominent but not very large. Antennae extending to hind coxae, basal joint large, second rather small, third to eighth still smaller and somewhat serrated, ninth about as long as the six preceding joints combined, slightly longer than tenth, and slightly shorter than eleventh. Prothorax moderately transverse, deeply notched on each side of base, each notch bounded in front by an acutely produced part of the side; with two large areolets on each side, the first extending from the apex to one-third from the base and closed, the other latero-basal, smaller, and open externally; granules as on head but more obscured by clothing. Elytra parallel-sided to near apex; with rows of large quadrate punctures, the interstices moderately convex, about the width of the seriate punctures, and minutely granulate. Pectoral canal deep from apex of prothorax to basal third of metasternum, a narrow, deep, median line from thence to apex of the latter. Under surface with dense and small granules, basal segment of abdomen almost half the length of second. Length, 5-6 mm.

Hab.—Tasmania: Lakes district (Rev. T. Blackburn and Aug. Simson), Hobart (Commander J. J. Walker and A. M. Lea); Victoria: Dividing Range (Blackburn).

At first glance fairly close to *A. australiense (Hadrobregmus)*, but prothorax less gibbous in middle, the notch on each side of the base much larger, the projection before each notch larger and more acute, and the eyes much smaller. The pubescence of the under surface and legs is somewhat paler than on the upper surface, and in some lights has a slightly golden gloss. The lateral areolets of the prothorax are separated by an obtuse sinuous ridge. In the figure of the antennae the third to ninth joints (inclusive) are shown as rather longer than they should be.

Anobium angustifuscum, n. sp.

Dark brown; antennae, palpi, and parts of legs paler. Clothed with rather short ashen pubescence.

Head with dense and minute punctures. Eyes prominent but not very large. Antennae with basal joint rather large, second much smaller, third to eighth much smaller, ninth slightly wider and slightly longer than tenth, and slightly wider and shorter than eleventh, the latter as long as second to eighth combined. Prothorax somewhat gibbous in middle near base, sides somewhat

triangularly produced downwards, front angles strongly concave, the hind ones less so; punctures dense and small. Elytra thin, parallel-sided to near apex; with rows of rather large, subquadrate, but shallow and asperate, punctures, becoming shallower posteriorly; interstices scarcely separately convex, except on sides, where the striation is moderately deep, with minute punctures. Basal segment of abdomen about half the length of the following one, all with curved sutures. Legs long and thin. Length, 3 mm.

Hab.—Tasmania (Rev. T. Blackburn).

A dark thin species. The front and middle coxae are conspicuously separated, but the intercoxal process of the mesosternum has an even slope, instead of being deeply concave, as in *A. domesticum* and closely allied species, and the median line of the metasternum is deep and wide on the posterior half, but absent from in front.

Pronus subhumeralis, n. sp. Fig. 26.

Dull castaneous-brown, legs and antennae paler; metasternum black or blackish, abdomen sometimes almost as dark. With very short, depressed, pale, uniform pubescence.

Head with minute punctures. Antennae eleven-jointed, basal joint and three joints of club large. Prothorax with minute punctures; margins somewhat projecting. Elytra parallel-sided to near apex; with rather fine but distinct striae, becoming deeper and containing more distinct punctures on sides; interstices with punctures as on prothorax. Metasternum with median line narrow; punctures minute. Abdomen with basal segment along middle fully as long as second or fifth, three median ones with straight sutures. Length, 2·75-3·5 mm.

Hab.—Lord Howe Island (A. M. Lea).

With some doubts this species is referred to *Pronus,* from the described species of which it differs in being considerably smaller and with smaller eyes; and the elytra with shallower striae, except on the sides, where they are deeper. It has the general appearance of the more elongate species of *Dorcatoma,* but the antennae pass over, instead of between the front coxae; the middle coxae are distinctly separated, but the space between them is transversely excavated and open, in *Dorcatoma* the cavity between them is concealed; in this species also the basal segment of the abdomen is large, and the legs are not capable of being received in special depressions. The male is usually slightly smaller and darker than the female, and his abdomen is sometimes almost black; both sexes usually have a latero-basal infuscation on each elytron, but it is sometimes absent, and its borders are never sharply defined. Specimens were obtained in abundance by beating shrubs over an umbrella. A badly-damaged specimen probably belongs to the species, but is almost entirely black or blackish.

Pronus marmoratus, n. sp.

Castaneous-brown or piceous-brown, sometimes almost black; antennae, palpi, and legs paler. Densely clothed with short ashen pubescence, darker in parts on elytra.

Head with dense minute punctures. Eyes small and prominent. Antennae with first joint and three joints of club large, second and third thin and moderately long, fourth to eighth shorter and feebly serrated. Prothorax with minute inconspicuous punctures. Elytra with puntcures as on prothorax, but towards and on each side with fairly well-defined striae, of which one curves around the apex and almost extends to the suture. Metasternum with a narrow median line; punctures as on upper surface. Two basal segments of abdomen large, the three median ones with straight sutures. Length, 2·25-3 mm.

Hab.—Norfolk Island (A. M. Lea).

In general appearance close to *P. subhumeralis,* but elytra without striae on sutural half, and with somewhat variegated pubescence. The males are usually darker than the females (several pairs were taken *in cop.*), sometimes their body parts being entirely blackish; the females are sometimes of a rather bright castaneous; but usually the metasternum and abdomen are darker than the prothorax and elytra; on pale specimens the suture is narrowly blackish. On each elytron the pubescence has several dark patches: a round one near the base and suture, a transverse postmedian one obliquely narrowed posteriorly, and a small subapical one, the three being sometimes narrowly joined together; the markings are usually quite distinct from certain directions, especially in the males, but on the females they are sometimes indistinct, and on abrasion are obscured or disappear. Numerous specimens were obtained by beating foliage, four were taken from fungi, and one from rotting leaves.

CALYMMADERUS.[10]

This genus is closely allied to *Dorcatoma* and *Mirosternus,* but is distinct by the club of the antennae, the basal joint of which is large, oblong, and as long as the two apical ones combined, or somewhat longer, the two apical ones are closely approximated, so as sometimes to appear but one. The front coxae are widely separated, and there is a concealed sternal cavity, but when the head is removed a distinct median notch in the breast is exposed.

Thaptor was proposed by Gorham for some Central American species, and an Australian one was referred to it by Pic; but the genus was subsequently considered as synonymous with *Calymmaderus.*

The Australian species before me may be thus tabulated:—

A. Elytra without sharply impressed lateral striae .. .. *pulverulens*
AA. Elytra with one sharply defined stria on each side .. .. .. *unistriatus*
AAA. Elytra with two on each side.
  B. Shining and with very minute pubescence .. .. *incisus*
  BB. Opaque and with longer, but still short, pubescence .. .. *inconspicuus*

Calymmaderus pulverulens, n. sp. Fig. 27.

Dark piceous-brown and shining, antennae and legs paler. Pubescence minute.

Head with dense and small punctures. Eyes large and with fairly large facets. Antennae with basal joint large, second and third moderately large, fourth to eighth small, ninth as long as seven preceding combined and longer than two following combined. Prothorax with minute punctures, becoming more distinct on sides. Elytra with small and minute punctures, striae feeble and lateral. Metasternum with a narrow median line, and with irregularly distributed punctures. Basal segment of abdomen distinct in middle, elsewhere almost concealed by the hind legs. Length, 3-3·25 mm.

Hab.—Norfolk Island (A. M. Lea).

An elongate-elliptic, strongly convex, shining species, with pubescence so extremely short that it causes the surface to appear dusty, rather than clothed. On the elytra the subbasal lateral swelling has larger punctures than elsewhere, although small; behind it two feeble striae commence, and are traceable almost to the suture, but they are nowhere sharply defined.

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(10) Solier, in Gay, Hist. d. Chile, Zool., iv., p. 472; Lacord., Gen. des Col., iv., p. 526.

Calymmaderus incisus, n. sp.

Bright castaneous and shining. With minute pubescence.

Head less shining than elsewhere; with dense and minute punctures. Eyes rather large and with large facets. Antennae with basal joint large, second moderately large, third to eighth small, ninth large, oblong, almost as long as the two following combined. Prothorax and elytra with minute punctures, striae of the latter confined to the sides. Metasternum with a narrow and rather deep median line. Basal segment of abdomen distinct only in middle, where it appears as a curvilinear triangle. Length, 2·75 mm.

Hab.—Queensland: Brisbane (A. J. Coates).

A shining species approaching the preceding, but paler, and with two well-defined striae on each side of elytra; the striae are feeble near the base, but suddenly become deeper beyond the latero-basal swelling, they then curve around the apex, where the upper one terminates, the lower being continued almost to the suture. The sternal notch is continued to the base of the middle coxae.

Calymmaderus inconspicuus, n. sp. Fig. 28.

Of a dingy subopaque brown. Densely clothed with short, depressed, ashen pubescence.

Head with dense and minute punctures. Eyes rather large. Antennae with basal joint large, second moderately large; first joint of club thicker and slightly longer than two following combined. Prothorax and elytra with dense and small or minute punctures, the elytra with faint traces of discal striation, and with two deep striae on each side. Metasternum more shining and with larger punctures than elsewhere, a deep median line confined to posterior half. Basal segment of abdomen distinct only in middle. Length, 3 mm. (vix.).

Hab.—Lord Howe Island, unique (A. M. Lea).

An oblong-elliptic species, with the general outlines of *C. pulverulens*, but subopaque, and elytra with two sharply defined striae on each side, beginning quite close to the base, and both curving around the apex, but only the lower one almost touching the suture. The sternal notch is continued as a narrow triangle between the middle coxae.

Calymmaderus unistriatus, n. sp.

Piceous-brown and feebly shining; with very short, depressed, ashen pubescence.

Head with dense and minute punctures. Eyes rather large and with large facets. Antennae with basal joint large, second rather large, the next seven small, basal joint of club as long as the seven preceding joints combined, or the two apical ones combined. Prothorax with crowded minute punctures. Elytra with punctures as on prothorax, but in addition with faint rows of slightly larger ones, each side with one conspicuous stria. Metasternum with rather sharply defined punctures in front, median line narrow and deep on posterior half only. Basal segment of abdomen distinct in middle. Length, 4 mm.

Hab.—New South Wales: Illawarra (G. Compere).

An oblong-elliptic, dingy species, with the general outlines of *C. pulverulens*, but with a distinct stria on each side; there are faint traces of striation containing very feeble punctures on the disc of the elytra, and towards the sides the punctures and rows become more distinct; beyond the latero-basal swelling the outer row suddenly alters to a narrow stria, which is continued around the apex almost to touch the suture.

Caenocara.

This genus is closely allied to *Dorcatoma*, of which it is sometimes regarded as a section; and, as in that genus, the front coxae of its species are widely separated, to allow the passage of part of the antennae into a concealed sternal cavity; in the male the basal joint of its club, however, has a produced part more than twice as long as its support.

The two Australian species here referred to the genus have the first joint of the club strongly produced to one side as in the European *C. bovistae*, and the abdomen (except as to its punctures) is somewhat similar, but the eyes are much larger.

Caenocara insignicornis, n. sp. Fig. 29.

Pale castaneous and shining, suture of elytra and some marginal parts of sterna narrowly infuscated. Densely clothed with short, pale, semierect pubescence.

Head with minute punctures. Eyes large and with coarse facets. Antennae with basal joint and three joints of club large. Prothorax with minute punctures, more distinct on sides than in middle. Elytra with small punctures, striae confined to sides. Metasternum with a narrow median line. Abdomen composed of apparently four segments, the true basal one being almost entirely concealed by the hind legs. Length, 2·75 mm.

Hab.—Tasmania: Frankford (— Walken in Simson's collection).

The antennae are composed of eight joints, of which three form a club; the first of these has a produced part more than twice as long as its support, the second is strongly dilated to apex and incurved there, and the third is elongate-reniform. There are two striae on the side of each elytron, but they are faint on the basal third, then they suddenly become deep, and are so continued around the apical curve, when the upper one terminates, the lower one being continued so as almost to touch the suture.

This species is certainly congeneric with the New Zealand *Cyphanobium illustre*, Broun (which accordingly should be transferred to *Caenocara)*, but differs from it in being somewhat larger, less densely clothed, the male (the only sex known to me) with somewhat smaller eyes, the second joint of club very different from the first, instead of similar, and the apical one shorter and stouter; the female of that species has antennae as on many species of *Dorcatoma*. Broun described the antennae as being composed of eleven joints, but he was probably deceived by the pubescence; under a compound power I can only see eight joints.

Caenocara vigilans, n. sp.

Reddish-castaneous and shining, pronotum somewhat darker, elytra piceous-brown; with short, dense, suberect, whitish pubescence.

Head with small and sparse punctures. Eyes large, each slightly wider than the interocular space, and with rather large facets. Antennae with basal joint and three joints of club large. Prothorax with minute punctures. Elytra with dense and minute punctures; striae confined to sides. Abdomen apparently composed of but four segments, the basal one being almost entirely concealed. Length, 2 mm.

Hab.—Northern Queensland (Blackburn's collection).

Differs from the preceding species in being smaller, narrower, and darker, eyes larger, and basal joint of club with a longer process. In appearance it is strikingly close to *Dorcatoma antennalis*, and it has similar striation, but the eyes are larger, club considerably larger, with the produced part of its basal joint almost thrice as long as its support, hence the species was referred to *Caenocara* rather than to *Dorcatoma*. There are two deep striae on the side

of each elytron, commencing near the base, and terminated evenly almost at the suture. Only one antenna is left on the type, so it was not detached for examination under a compound power, and I was unable to count the joints between the large basal one and the club.

DORCATOMA.

Unset specimens of this genus have the head with the tips of the mandibles resting on the intercoxal process of the metasternum, entirely concealing the middle of the prosternum, mesosternum, and the front coxae, with the antennae and legs received in appropriate cavities, so as not to interrupt the continuity of outlines. When the head and prothorax are removed, it may be seen that a large cavity exists in the metasternum for the reception of the joints of the clubs, and that the mesosternum has been forced back, so as to appear as a vertical wall on each side, and to be quite concealed in the middle by the overlapping intercoxal process of the metasternum, much as in the Hawaiian genus *Mirosternus*, but they are without the deep and wide median line on the metasternum, characteristic of that genus; the front coxae are widely separated, so as to allow of the passage of part of the antennae to the concealed cavity. The eyes vary considerably in size, but their facets are usually large. They all have the basal joint of antennae large, and the three apical ones large (usually very large), and forming a loosely compacted club, of which the first and second joints are more or less triangular, the intervening joints are small and difficult to count. The abdomen of most species from the sides appears to be composed of four segments, with the sutures well defined, but the sutures often tend to obliteration, or at least to become indistinct in the middle; the true basal segment is normally concealed by the hind legs, except in the middle, where it appears as a small intercoxal process, and the extreme margins, which sometimes appear as narrow shining rims behind the coxae. They all have short, more or less uniform, pubescence or setae, usually erect or suberect, but occasionally depressed. The Australian species here referred to the genus may be roughly divided into two sections:—1. Those of a short, broad, "dumpy" form, usually with fine striae near the suture of elytra, as well as stronger ones on the sides, and those of rather more elongate but still compact form (as the European *D. chrysomelina* and *D. flavicornis)*, with elytral striation usually confined to the sides, and basal segment of abdomen more distinct. The head of at least one specimen of every species, here described, has been detached from the body, so that the coxae and concealed parts of the sterna could be examined, as well as the under surface of the head itself; and an antenna of each was usually mounted in Canada balsam, for examination under the microscope. The tarsi are usually paler than the rest of the legs, but they are normally concealed.

Gorham[11] considered *Dorcatoma* contained forms with 11, 10, and 8 joints to the antennae, and that *Caenocara* was only a section of it. *D. lanigera,* Oll., is here commented upon as the type of a new genus, *Aulacanobium*.

TABLE OF AUSTRALIAN SPECIES OF *Dorcatoma*.

A. Head with a Y-shaped impression between eyes .. .. .. *interocularis*
AA. Head with two deep longitudinal grooves joining clypeal suture .. *bisulciceps*
AAA. Head without special impressions behind clypeal suture.
  B. Elytra with rows of large punctures on sides near base.
    a. Punctures enclosed within the striae .. .. *norfolcensis*
    aa. Punctures extending beyond the striae .. .. *punctilatera*
  BB. Elytra without rows of large punctures on sides near base.
    C. First joint of club much wider than long.
      b. Almost circular; eyes rather small .. .. *subcircularis*
      bb. Elliptic-ovate; eyes large .. .. *antennalis*

[11] Gorham, Biol. Cent. Amer., Coleoptera, iii., part 2, p. 208.

CC. First joint of club longer than wide, or scarcely wider than long.

D. Elytra without distinct lateral striae; club blackish.

c. Pubescence wavy .. .. *rhizobioides*

cc. Pubescence not wavy .. .. *elliptica*

DD. Elytra with distinct lateral striae.

E. Each elytron with one stria or none between the suture and lateral ones.

d. Each side with three distinct striae .. .. *atripennis*

dd. Each side with less than three striae.

e. Eyes large .. .. *punctipennis*

ee. Eyes small .. .. *marginalis*

EE. Each elytron with two striae between the suture and lateral ones.

f. More than 2 mm. long .. .. *modica*

ff. Less than 2 mm. long .. .. *minima*

EEE. Each elytron with more than two striae between the suture and lateral ones.

F. Elytra at basal third with striae at regular intervals from suture to sides.

g. Eyes large; elytra castaneous .. .. *irrasa*

gg. Eyes small; elytra deep black .. .. *aterrima*

FF. Elytra with an interval between suture and each side where no striae are traceable.

G. Conjoint width of eyes equal to or wider than interocular space.

h. More than 2·5 mm. long .. .. *macrops*

hh. Less than 2·5 mm. long .. .. *simulans*

GG. Conjoint width of eyes less than width of interocular space.

H. Less than 3 mm. long .. .. *tasmaniensis*

HH. Not less than 3 mm. long .. .. *corticalis*

Notes on Table.

E, EE, and EEE. The striae near the suture are usually faint, but are traceable in certain lights.

hh. On *D. simulans,* in some lights, very faint striation may be traced beyond the shoulders, but it is very feeble and invisible from most directions.

Dorcatoma interocularis, n. sp. Fig. 30.

Dark piceous-brown, sterna almost black, antennae paler; with short, suberect, pale, setose pubescence.

Head finely granulate or shagreened, with a Y-shaped impression between eyes; clypeal suture deep, with two small impressions touching its hind edge. Antennae apparently ten-jointed, first joint large, second moderately large, the five following ones small, but two of them produced to one side; first joint of club large, produced on one side and rounded there, second subtriangular, third slightly longer and thinner. Prothorax with dense and small punctures. Elytra with similar punctures, with fine but distinct striae almost or quite disappearing posteriorly, except that on each side there is a conspicuous one from base to apex. Under surface with more distinct punctures than upper surface; metasternum with larger and sparser punctures than abdomen, and with a very narrow and faint median line. Length, 3 mm.

Hab.—New South Wales: Wollongong (A. M. Lea).

Very distinct from the other Australian species by the Y-shaped impression on the head, its three parts are narrowly impressed, but the Y itself is rather wide. The abdomen appears to be composed of but four segments, as only minute parts of the true basal one are visible. The legs of the type have not been removed from their cavities, but as the head has been detached the front coxae are seen to be widely separated. The eyes are of moderate size, and with rather large facets.

Dorcatoma bisulciceps, n. sp.

Blackish, prothorax and abdomen obscurely paler, antennae obscurely reddish. Pubescence short and pale.

Head with two, deep, narrow grooves, close together from about half-way between eyes, to where they terminate in the deep clypeal suture. Antennae with basal joint and three joints of club large, the intervening ones small and apparently five in number. Prothorax with minute punctures. Elytra with fairly distinct punctures, with fine striae on disc almost disappearing posteriorly, each side with three well-defined striae towards base, but only one continuous to apex. Under surface as described in preceding species. Length, 3 mm.

Hab.—New South Wales (Blackburn's collection); Queensland: Mount Tambourine (A. M. Lea).

In appearance close to the preceding species, but slightly darker, elytra with lateral striae more distinct towards base, and head with two deep longitudinal grooves. The pubescence is semierect and appears to be easily abraded, as one specimen has most of the upper surface glabrous. Under a fairly high power of the microscope I can count only five joints between the large basal joint of antennae and the club, so that the antennae appear to be nine-jointed; it is probable, however, that they really have ten joints.

Dorcatoma irrasa, n. sp. Figs. 16, 17, 31.

Castaneous. Uniformly clothed with short, semierect, setose pubescence.

Head with inconspicuous punctures. Eyes large, facets rather small. Antennae with basal joint and three joints of club large. Prothorax with small and rather dense punctures, larger on flanks than in middle. Elytra with dense and small punctures, striation fine but well defined, except on parts of apical slope, deeper on sides than elsewhere, but only one stria on each side traceable to apex. Metasternum with sparser and more sharply defined punctures than on upper surface; median line feeble. Abdomen apparently composed of four segments, the first being almost entirely concealed. Length, 2·75-3 mm.

Hab.—Western Australia: Donnybrook (A. M. Lea).

A comparatively large castaneous species, the elytra with distinct striation, except on parts of the apical slope, where, owing to the greater density of the punctures, they are indistinct or absent. Some specimens are slightly darker than others, and some have the legs and mandibles perceptibly darker than the sterna and abdomen. Under a hand lens the antennae appear to be composed of a large basal joint, two small following ones, and a club of three large joints; but under a compound power they are seen to be eleven-jointed.

Dorcatoma corticalis, n. sp.

Blackish-brown, sterna black, club reddish. With uniform, short, semierect, ashen pubescence.

Head opaque and with crowded but rather sharply defined punctures. Eyes not very large, but with rather large facets. Antennae with basal joint large and a club of three large joints, the intervening joints small and seven in number. Prothorax with dense, partially concealed, punctures. Elytra with two deep striae on each side, one short, the other traceable to apex, elsewhere with fine striae, but disappearing about apical slope, where the punctures are denser than elsewhere. Metasternum with a narrow but well-defined median line. Length, 3-3·75 mm.

Hab.—South Australia: Adelaide, Pillaworta, under bark (Rev. T. Blackburn), Mount Lofty (S. H. Curnow, A. H. Elston, and J. G. O. Tepper); Tasmania: Launceston (Aug. Simson).

Structurally close to *D. irrasa,* but darker, with denser and somewhat larger punctures, head less shining, and with smaller eyes; as on that species the true basal segment of abdomen appears as a narrow shining rim behind the hind coxae. Under the microscope the antennae appear to be almost exactly as in fig. 31. At first glance the specimens appear to be entirely black, but on close examination the metasternum and legs are seen to be darker than the adjacent parts, the club is pale, but is normally concealed. For a short distance there are two deep striae on the side of each elytron, but only one is continuous. As viewed back downwards the sides and apex of abdomen appear to be enclosed by a double elytral margin, but one of these margins really consists of a narrow edging of the abdomen itself; a somewhat similar but less conspicuous double edging may be seen on other species.

Dorcatoma macrops, n. sp.

Blackish, head and antennae paler. With short, more or less erect, ashen pubescence.

Head, antennae, and prothorax as described for *D. irrasa.* Elytra with more distinct punctures than on prothorax, striation well defined near suture, faint or absent about middle and about apical slope, each side with three deep striae near base, but only one of these traceable to apex. Metasternum with a well-defined but narrow median line. Length, 2·75 mm.

Hab.—New South Wales: Illawarra (G. Compere).

Structurally close to *D. irrasa* but darker, and smaller than the average size of that species, with the median line of metasternum more sharply defined; in colour it is nearer to *D. corticalis,* but the lateral striae more nearly resemble those of the first-named one. So far as the antennae could be examined under the microscope, without detaching them from the head, they appear to be composed of eleven joints, as in *D. irrasa,* but the first joint of the club is more pointed inwards (triangular) than on that species. Of the two specimens taken by Mr. Compere one has the metasternum and abdomen of the same shade of colour, on the other the metasternum is slightly the darker. A specimen from Queensland (Mount Tambourine, A. M. Lea) probably belongs to the species, but the elytral striae are somewhat fainter, and the abdomen and head are uniformly reddish.

Dorcatoma tasmaniensis, n. sp. Fig. 32.

Deep black, prothorax obscurely diluted with red, head slightly paler, club of antennae still paler. With short, ashen, semiupright pubescence, sparser on elytra than elsewhere.

Head shining and with rather inconspicuous punctures; clypeal suture deep and moderatly curved. Eyes comparatively small. Antennae with basal joint and three joints of club large, the intervening ones small. Prothorax with dense and small punctures. Elytra with slightly larger punctures than on prothorax, striation distinct in parts. Metasternum with median line very narrow but distinct. Length, 2·5 mm.

Hab.—Tasmania (Aug. Simson), Hobart, from fallen leaves, Latrobe, in flood *débris,* Mole Creek (A. M. Lea).

Structurally close to *D. macrops,* but smaller and somewhat wider in proportion, eyes distinctly smaller, median line of metasternum thinner and less deep, and abdominal sutures less distinct across middle. There are three fairly distinct striae and a feeble one (the latter sometimes absent) on each side of the suture from near the base to about the middle, when they disappear; on each side there are three well-defined ones, but only one of these extends to

the apex. There are probably eleven joints to the antennae, but I can only count six between the large basal joint and the club.

Dorcatoma modica, n. sp. Fig. 33.

Dark castaneous-brown, head and antennae paler. With short suberect pubescence.

Head shining and with small punctures. Antennae with basal joint and three joints of club large. Eyes large and with rather large facets. Prothorax with minute punctures, becoming somewhat larger on sides. Elytra with small but rather sharply defined punctures, striation distinct near suture and on sides. Metasternum with median line very narrow, but slightly dilated at the ends. Length, 2·5 mm.

Hab.—Northern Queensland (Blackburn's collection), Cairns (E. Allen).

About the size of *D. tasmaniensis,* but less dark, with decidedly larger eyes and median line of metasternum different. Each elytron has two fairly distinct striae near the suture, of which the first terminates slightly beyond the middle, the second slightly before it, there are three deep striae on each side, but only one of these curves round so as almost to touch the suture. The antennae are probably eleven-jointed, but even under a fairly high power of the microscope I could not count the number of joints between the large basal one and the club.

A specimen from southern Queensland (Dalby, Mrs. F. H. Hobler) probably belongs to this species, but is smaller, 2·25 mm., rather less dark, and of the striae near the suture the first is feeble and the second is traceable with difficulty.

Dorcatoma antennalis, n. sp. Fig. 34.

Black, head and abdomen obscurely reddish, antennae paler. With short, dense, suberect, pale pubescence.

Head shining and with minute punctures. Eyes large and with rather large facets. Antennae with basal joint, and three joints of club large. Prothorax with fairly distinct punctures on sides, but feeble elsewhere. Elytra with minute punctures, striae distinct only on sides. Median line of metasternum very narrow. Length, 2·25 mm.

Hab.—Queensland: Cairns (A. M. Lea).

At first glance apparently belonging to the preceding species, but distinct by the sides of elytra and antennae; each side has two deep striae commencing near the base, and curved round so as almost to touch the suture, and a shallower marginal one that connects with the sutural stria; the sutural one is distinct on the apical slope, elsewhere it is faintly traceable only in certain lights. The first joint of the club has a produced part almost twice the length of its support, and denoting an approach to *Caenocara,* the second is triangularly dilated to the apex, with the apex slightly incurved, and the apical joint longer but thinner than the others. I could not count the joints between the first and the club, but they are certainly more than four in number. The elytral pubescence from certain directions appears to be slightly lineate in arrangement.

A specimen from northern Queensland (Blackburn's collection) appears to belong to this species, but is smaller (2 mm.) and mostly castaneous, the elytra only being of a rather dark brown.

Dorcatoma simulans, n. sp.

Dark brown, head and abdomen paler, antennae still paler. With dense, short, pale, suberect pubescence.

Head shining and with small punctures. Eyes large, with rather large facets. Antennae with basal joint and three joints of club large. Prothorax

with minute punctures, becoming larger and denser on sides. Elytra with rather sharply defined punctures, striation distinct near suture, feeble in middle, deep on sides. Median line of metasternum narrow. Length, 2-2·25 mm.

Hab.—Northern Territory: Darwin (W. K. Hunt).

In general appearance close to *D. modica* and with similar eyes and antennae, but elytral striae different; on each elytron there are two distinct striae near the suture (but vanishing on the apical slope), then some feeble ones, but sufficiently clear in certain lights, then three well-defined ones on the side; of these the first is short, the next extends to about level with the base of the subapical segment, and the third is deepened and curves around so as almost to touch the suture. From some directions the elytral pubescence appears distinctly lineate in arrangement. Two of the seven specimens before me have the elytra and metasternum almost black, another is almost entirely castaneous.

Dorcatoma aterrima, n. sp.

Deep shining black, antennae obscurely reddish.

Head with minute punctures. Eyes much smaller than usual. Antennae with basal joint and three joints of club large. Prothorax with minute punctures, becoming comparatively large on sides. Elytra with rather sparse but well-defined punctures on basal half, becoming crowded posteriorly; basal half with well-defined striae, becoming longer on sides, but only one traversing the densely punctate space so as almost to touch the suture. Metasternum with a narrow median line, and with distinct punctures, but much sparser than on abdomen. Length, 2·5 mm.

Hab.—New South Wales (Blackburn's collection).

The intensely black colour and the comparatively small eyes readily distinguish the present species from the others here referred to *Dorcatoma*, it appears to be nearest of all to *D. tasmaniensis*, but has smaller eyes and more distinct striation; the dense punctures on the posterior half of the elytra cause the surface to appear shagreened, and interrupt all the striae except a deep submarginal one. On the type there is a slight amount of pubescence on the sides of prothorax, on the shoulders and about the apex of abdomen, elsewhere the surface is shining and glabrous; but probably it has been much abraded, thus rendering the punctures and striae unusually distinct.

Dorcatoma atripennis, n. sp.

Black, prothorax, and abdomen obscurely paler, head and antennae slightly paler still. With short, suberect, ashen pubescence.

Head shining and with minute punctures. Eyes of moderate size and with rather large facets. Antennae with basal joint and three joints of club large. Prothorax with small punctures, but becoming larger on sides. Elytra with small and rather dense punctures, striation distinct only on sides. Length, 2 mm.

Hab.—Northern Queensland (Blackburn's collection).

At first glance apparently belonging to *D. antennalis*, but first joint of club and elytral striation very different. The second joint of the antennae is of moderate size, but between it and the club the articulation is indistinct; the first joint of the club is strongly rounded on its inner side, and not as wide as long, the second is subtriangular, and the third thinner (in preparing the antennae of the type for mounting in Canada balsam, the apical joint of each was lost). There is but one stria on each elytron near the suture, faint on the basal half, and not traceable elsewhere; on each side there are three distinct ones, of which the inner one is narrower and shorter than the others, the latter about the middle are conjoined to continue as a deep one, which curves around

the apex almost to the suture. The median line of the metasternum is wider than in any of the preceding species, it is fairly deep near the base, and becomes shallower and wider posteriorly; the abdominal sutures are very indistinct across the middle.

Dorcatoma punctipennis, n. sp. Fig. 35.

Reddish-castaneous, metasternum darker, elytra still darker (mostly almost black). With short, dense, suberect, pale pubescence.

Head shining and with minute punctures. Eyes large and with rather large facets. Antennae with basal joint and three joints of club large. Prothorax with minute punctures, becoming larger and denser on sides. Elytra with rather dense and small but sharply defined punctures, striation confined to sides. Metasternum more convex and with somewhat denser punctures than usual in the middle, but sparser elsewhere; median line traceable only at ends. Length, 2 mm.

Hab.—Lord Howe Island (A. M. Lea).

Close to *D. modica,* and with very similar eyes, but basal joint of club more triangularly produced on one side, and each elytron with only one distinct stria. The first and second joints of the club are triangular, but the first is wider than long, the second longer than wide; under a fairly high power of the microscope I could only count four joints between the large basal joint of the antennae and the club. The distinct stria on each elytron is near the side, and begins level with the hind coxa, it then curves around so as almost to touch the suture, but between it and the outer margin a very faint one may be traced. A second specimen differs from the type in being decidedly smaller (1½ mm.), somewhat paler, with the median line of metasternum faintly traceable in the middle, and the elytral punctures rather less sharply defined; it probably belongs to the species, but its antennae were not examined.

Dorcatoma minima, n. sp.

Reddish-castaneous, elytra and metasternum slightly darker than elsewhere, club of antennae paler. With short, semierect, pale pubescence.

Head shining and with minute punctures. Eyes rather large and with large facets. Antennae with basal joint and three joints of club large. Prothorax with small punctures on sides, minute elsewhere. Elytra with dense and small punctures, striation faint except on sides. Median line of metasternum narrow but distinct. Length, 1·25 mm.

Hab.—Queensland: Dalby (Mrs. F. H. Hobler).

A minute species, smaller and somewhat narrower than any of the preceding ones. There are two short striae on each elytron near the suture, but they are very faintly indicated, and are invisible from several directions; there are three striae near each side, but of these two are rather feeble and short, only one being deep and curved around so as almost to reach the suture. I was unable to count the number of joints of antennae between the first and the club.

Dorcatoma subcircularis, n. sp. Fig. 36.

Deep shining black, antennae reddish. With short, semierect, whitish pubescence.

Head with rather sparse and small punctures. Eyes not very large, facets rather small. Antennae with basal joint and three joints of club large. Prothorax with rather small but sharply defined punctures, becoming denser and

larger on sides. Elytra conjointly slightly wider than long; with rather sharply defined punctures, striae confined to sides. Metasternum rather strongly convex; with comparatively coarse punctures; median line scarcely indicated. Length, 1·25 mm.

Hab.—Northern Queensland (Blackburn's collection).

An unusually compact species (1·5×1·25×1 mm.), readily distinguished by its almost circular outline, deep black colour, and by the triangular production of the basal joint of the club of antennae (the produced part being almost twice as long as its support) indicating an approach to *Caenocara*. Its antennae and striae are nearer those of *D. antennalis* than any other species, but it is conspicuously wider and darker. On the elytra there are no striae near the suture, but the punctures there have a faintly lineate appearance; on each side there are three deep striae, one of which is very short, the others curve around the apex, but one approaches more closely to the suture than the other. Under a fairly high power of the microscope I could not count more than five joints between the basal joint of antennae and the club.

Dorcatoma punctilatera, n. sp. Fig. 37.

Dark piceous-brown, antennae and legs paler. With dense, short, suberect, ashen pubescence.

Head shining and with minute punctures. Eyes not very large but with rather large facets. Antennae with basal joint and three joints of club large. Prothorax with dense and minute punctures, scarcely larger on sides than in middle. Elytra with slightly larger punctures than on prothorax, and with more or less regular rows of slightly larger ones, becoming conspicuous on sides. Metasternum with median line narrow but distinct on apical half, not traceable towards base. Length, 2-3 mm.

Hab.—Lord Howe Island (A. M. Lea).

Some specimens are darker than others, their elytra and sterna being black or almost so, on many the head and abdomen are paler than the adjacent parts, but not as pale as the antennae and legs. At first the elytra appear to be faintly striated, with the striae deep on the sides, but this appearance is caused by rows of small punctures, with the interstices faintly undulated; on each side there are three conspicuous rows of punctures, of which the uppermost is short, the other rows consist of larger punctures, but posteriorly they become smaller, and one row really alters to a stria, which almost touches the suture. On the under surface of the head there are two rather small subfoveate impressions near the base (but not deeply bisinuate impressions, as in *Lasioderma* and allies); and the front coxae are widely separated, to allow the passage of the apical joints of antennae into the normally concealed sternal cavity. Numerous specimens were obtained by beating shrubs; one was taken from a tree-fern, and another from fallen leaves. Two small specimens are entirely bright castaneous, except that the antennae and parts of the legs are almost flavous; on one of them the seriate punctures on the elytra are also larger.

This and all the following species, regarded as of the second group, are more or less oblong-elliptic, with the elytra partly parallel-sided; on all the preceding species, regarded as of the first group, the shape is more elliptic-ovate, with the elytra bulging out where they join the prothorax; their abdominal sutures (unless otherwise noted) are clearly indicated in the middle. The legs appear to be capable of being received into cavities quite as deeply as in those species, but as seen they are usually partly free.

Dorcatoma norfolcensis, n. sp. or var.

Dark brown or blackish, antennae and parts of legs reddish. Length, 2·25-2·75 mm.

Hab.—Norfolk Island (A. M. Lea).

Nine specimens from Norfolk Island differ from specimens of the preceding species in having the rows of punctures on the elytra (except the lateral ones) scarcely, if at all, indicated; the punctures in the three outer rows are somewhat smaller than on that species, and those of the outermost row appear to be confined to a stria, and are not as wide as the interstice between two rows; on the preceding species the punctures in the basal half of the outer row extend beyond the limits of the stria, and are distinctly wider than the interstice between two rows. They are also slightly less robust and have somewhat larger eyes (in both sexes); but it is possible that they should be regarded as representing a varietal or subspecific form only.

Dorcatoma rhizobioides, n. sp. Fig. 38.

Black, parts of antennae and of legs reddish. Densely clothed with short, depressed, pale-ashen pubescence, somewhat waved on upper surface.

Eyes small and prominent. Antennae with basal joint and three joints of club large. Elytra faintly undulated. Metasternum with median line rather narrow but somewhat dilated in middle. Basal segment of abdomen rather short behind coxae, but distinct from side to side. Length 2·25-2·5 mm.

Hab.—Norfolk Island (A. M. Lea).

A narrow species with wavy pubescence (as on many small Coccinellidae); the sides of the elytra are faintly undulated but are non-striated. The punctures are concealed by the pubescence, but appear to be everywhere dense and very minute. The antennae are ten-jointed and dark, almost black, except that the small joints between the basal one and the club are almost flavous; the two basal joints of the club are triangularly dilated to, and incurved at, apex; on the male they are considerably larger than on the female. Seven specimens were obtained. It is smaller and darker than the New Zealand *D. oblonga,* but is close to it in many respects.

Dorcatoma elliptica, n. sp. Fig. 39.

Black, small joints of antennae and parts of legs reddish. With short, depressed, ashen pubescence.

Eyes small and prominent. Antennae with basal joint and three joints of club large. Elytra with faintly impressed rows of punctures on sides towards base, but disappearing posteriorly. Metasternum with median line distinct on posterior two-thirds, and narrowly impressed along its middle. Basal segment of abdomen rather short but distinct from side to side. Length, 2·5 mm.

Hab.—Lord Howe Island (A. M. Lea).

A narrow species, structurally close to *D. rhizobioides,* and with very similar antennae, but pubescence not at all waved, and faint punctures on sides of elytra, not becoming sharply impressed striae as on species of the first section of the genus; elsewhere the punctures are very minute and normally concealed by the clothing.

Twelve specimens from Tasmania, Kelso (Aug. Simson), Wilmot (H. J. Carter and A. M. Lea), Hobart, Ulverstone, and Marrawah (Lea) differ in being somewhat larger (up to 3 mm.), and with the punctures at sides of elytra even less distinct, two of them also have the elytra obscurely diluted with red (the margins rather more noticeably); but I can find no differences warranting their being considered as specifically distinct.

Dorcatoma marginalis, n. sp.

Piceous-brown, antennae and parts of legs paler. With short, suberect, ashen pubescence.

Head with dense and minute punctures. Eyes small and with rather large facets. Antennae with basal joint and three joints of club large, first joint of club slightly longer than its apical width and slightly larger than second. Prothorax with dense and minute punctures, becoming somewhat larger on sides. Elytra with dense and small punctures; striae confined to sides. Metasternum with median line very narrow but continuous from base to apex. Abdominal sutures scarcely traceable across middle. Length, 2·5 mm.

Hab.—Victoria: Alps (Rev. T. Blackburn).

The elytra are without the least evidence of striation near the suture; on each side near the base there are very feeble striae, but beginning level with the hind coxa there are two distinct ones, the upper short, the other deepened and continued around the apex so as almost to touch the suture. The first joint of the club not wider than long at once distinguishes the species from *D. antennalis* and *D. subcircularis,* whose lateral striae are also deeper and longer; *D. atripennis* is a smaller and darker species, with longer and stronger lateral striae; *D. punctipennis* is darker, with stronger elytral punctures and much larger eyes. On the type the head and abdomen are obscurely paler than the elytra and metasternum. I could not count the number of joints in the antennae between the large basal joint and the club.

BLACKBURNIELLA, nov. nom., FOR THANASIMOMORPHA, Blackb. (COLEOPTERA: CLERIDAE).

By Edward A. Chapin, Ph.D., Washington, D.C.

(Communicated by Albert H. Elston, F.E.S.)

[Read May 8, 1924.]

The International Code of Zoological Nomenclature in its present form is framed with the avowed intention of removing, as far as possible, the personal element from among the factors upon which any case is decided. For this reason, it would seem to the writer that when any case arises which is not completely or definitely covered by the Code, its solution should, if possible, depend on factors applicable to all similar cases and not upon points which have a peculiar bearing on the individual case.

The subject under discussion at present is the genus *Thanasimomorpha*, Blackburn, 1891, of the Coleopterous family Cleridae. In a recent paper, Mr. Albert H. Elston advocates the suppression of the original type designation of the genus because of an obvious misidentification, and designates as genotype another of the originally included species. If Mr. Elston's argument is accepted, a precedent is established which will quite probably open the way for numerous changes in the names of genera erected by Fabricius, DeGeer, and other early workers.

The Rev. H. S. Gorham, in 1877, made the following statement in regard to *Tillus bipartitus*, Blanchard:—"The former most resembles a *Thanasimus*, but has the palpi all securiform; . . . *Tillus hilaris*, Westwood, is congeneric with *bipartitus*, which it much resembles." From this it is evident that Gorham had an erroneous idea of both the above-mentioned species, for, thanks to Lesne's re-examination of the type of *bipartitus*, Blanch., we definitely know the first-mentioned species to be a synonym of *Tillus notatus*, Klug., while the second is known to be very closely related to *Tarsostenus univittatus*, Rossi.

In the Transcactions of this Society for 1891, page 304, the Rev. Canon Blackburn proposed the new genus *Thanasimomorpha* as follows:—

"*Thanasimomorpha* (gen. nov.). Thanasimo affinis; different palporum maxillarium articulo ultimo securiformi. The Rev. H. S. Gorham (Cist. Ent., ii., p. 62) points out the necessity of a new genus for *Tillus bipartitus*, Blanch., but without proposing one. I therefore suggest the above name. Another member of the genus (as Mr. Gorham points out) is *Clerus guttulus*, White."

This is followed by the description of *(Thanasimomorpha) intricata*, n. sp., said to be related to *bipartitus*, Blanch.

It is obvious that Blackburn's generic diagnosis is a translation of the remark of Gorham without augmentation. The citation of Gorham as authority for the inclusion of *Clerus guttulus*, White, in the genus is contrary to fact. There is no evidence of personal knowledge of the species involved here, and, again, there is evidence of misidentification of species, for *guttulus*, White, is a *Tarsostenodes*, and is quite unlike either a *Tillus* or the insect known as *Thanasimomorpha intricata*.

It is Elston's contention that a misidentification is evident, that the species *intricata* is closely related to the insect assumed by Blackburn to be *bipartitus*, Blanch., that the *bipartitus* of Blackburn (an unnamed species) is definitely

known, and that the selection of *intricata,* Blackb., would conform with the conception of *Thanasimomorpha* as held by Blackburn. This is undoubtedly true, for the external evidence in the form of Blackburn's collection and his subsequent written work is at hand. It is true, however, that the inclusion of *guttulus,* White, by Blackburn in the genus introduces evidence detrimental to Elston's case. Even if the Code permitted such a solution as Elston proposes, it is sufficient, I believe, to prevent any such settlement from being permanent. On the other hand, *Tillus bipartitus,* Blanch., is the type of *Thanasimomorpha,* Blackb. Of this there can be no doubt. Blackburn selected the species, so far as one can know from his paper, in good faith. Here, at least, is a solution of the problem which, though unpleasant, is not open to attack. Let us grant that the type of a genus is that species which the author, or some later worker, designates, and allow the generic name to stand or fall, as its designated type stands or falls, regardless of misidentification.

Many genera are based on Linnean species. In many cases, there is external evidence to show that the Linnean species was misidentified by the author of the genus. More often there is no evidence one way or another. The only hope of salvation for the nomenclature, already so unwieldy as to almost overpower us, is to accept definite statements of type as fact regardless of external evidence to the contrary.

For the reasons expressed above, I believe it necessary to consider *Thanasimomorpha,* Blackb. (type, *Tillus bipartitus,* Blanch.), as a synonym of *Tillus,* Oliv., and to select a name for the genus of which *intricata,* Blackb., is a member. There appears to be no available published name. At one time it was thought that a case could be made for the retention of *Thanasimorpha,* a form apparently first used by Lodhe, 1900. However, this name is obviously the result either of a *lapsus calami* or a typographical error, it matters not which. As such it is subject to correction according to the Code, and a solution based on this name would be no solution at all. These being the facts as they appear to me, I propose the new genus *Blackburniella,* with *Thanasimomorpha intricata,* Blackb., as type species. I fully appreciate Mr. Elston's point of view, both as published and indicated in personal letters, and I interfere with *Thanasimomorpha* only with deep regrets.

THE FLORA AND FAUNA OF NUYTS ARCHIPELAGO AND THE INVESTIGATOR GROUP.

No. 16.—THE CRUSTACEA.

By Herbert M. Hale, South Australian Museum.
(Contribution from the South Australian Museum.)

[Read May 8, 1924.]

Plates IV. and V.

The following list of the Crustacea collected includes specimens dredged from the "Conqueror," in 3 to 4 fathoms, in the neighbourhood of the group of islands forming Nuyts Archipelago; others captured on Pearson and Flinders Islands, and a few examples taken on the mainland opposite to the Archipelago.

DECAPODA.

Suborder Natantia.

Tribe CARIDES.

Family PANDALIDAE.

Pandalus, Leach.

Subgenus Parapandalus, Borradaile.

In recording some specimens taken by the Expedition, it seems advisable to here discuss the forms taken in South Australian waters.

Pandalus (Parapandalus) leptorhynchus, Stimpson.

Pl. iv., figs. 1-5.

Pandalus leptorhynchus, Stimpson, Proc. Acad. Nat. Sci., Philad., xii., 1861, Sp. 447; Haswell, Cat. Aust. Crust., 1882, p. 197.

Form very slender in male, slightly more robust in female. Rostrum sub-filiform, tapering, scarcely compressed, a little upwardly curved, slightly shorter or slightly longer than scaphocerites, distinctly longer than antennular peduncles, and less, or a very little longer, than the medial length of carapace; a slender, immovable, spine-like tooth on upper surface near base and from two to five smaller ones below, the first situated usually at about the middle of the length, the minute anterior one close to the acute rostral tip. First joint of antennular peduncle about twice as long as the second and third together, constricted in the middle and bent upwards in front of the constriction; base broad and produced laterally to form a scale with an acute apex, which does not attain to the level of the apex of the first peduncular joint; flagella subequal in length, longer than the peduncle. Scaphocerite rounded distally, the spine at termination of outer margin small. A distinct ocellus on dorsal margin of eye. Carapace with a slender median spine immediately behind base of rostrum, which forms a weak crest on the anterior portion of the carapace. Third segment of the abdomen with a depression on each side of the posterior margin, which is thus a little compressed to form a rounded median carina. Sixth segment twice as long as greatest width and about as long as telson. External maxillipeds not quite reaching to apex of antennal scale. First pair of legs very slender, extending as far forward as maxillipeds. Carpos of second pair three-jointed,

the second and third joints together about one-ninth longer than first, which is almost twice as long as the third; third pair longest, extending slightly beyond apex of antennal scale. Last three pairs slender, with the claw-like dactylus folding back against the propodus.

Length, from tip of rostrum to posterior margin of third abdominal segment (largest example), 21 mm.; rostrum, 7 mm.

Hab.—New South Wales: Port Jackson (Stimpson). South Australia: St. Vincent Gulf (W. H. Baker and H. M. Hale), St. Francis Island (Sir Joseph Verco), Ardrossan (Cadd). Western Australia: Geographe Bay, 15-16 fms. (Sir Joseph Verco).

The spines on the lower side of the rostrum vary in number, but usually three are present; in a series of fifty specimens from St. Vincent Gulf, three have two spines below (as described by Stimpson), thirty-one have three, fifteen have four, and one example has five. Specimens taken at Nuyts Archipelago represent a simple variety:—

Rostrum at least one-fourth longer than carapace and about twice as long as the antennular peduncles; almost straight anteriorly, curving gently upwards from the neighbourhood of the first inferior spine; with a single superior spine, near base, and three, four, or five spines below, regularly decreasing in size anteriorly; the first is placed at, or a little in advance of the posterior third of the rostrum, the last is minute, subapical. Antennular flagella subequal, extending as far as, or slightly beyond tip of rostrum.

Length (largest example), 23 mm.; rostrum, 8·7 mm.

Hab.—South Australia: Nuyts Archipelago (dredged from "Conqueror") and Spencer Gulf.

Pandalus (Parapandalus) leptorhynchus, var. *gibber*, var. nov.

Pl. iv., figs. 6, 7.

♀. Rostrum a little longer than carapace, with a single dorsal spine near base and another distinct inferior spine near apex. Carapace with a spine behind base of rostrum. Third segment of abdomen strongly compressed dorsally, and elevated above the level of the preceding segments. Telson longer than sixth abdominal segment. Legs moderately stout; carpos of the second pair three-jointed, the second and third joints together one-half longer than the first, which is about one-third longer than the third joint.

Length, 31 mm.; rostrum, 10·5 mm. (S. Austr. Mus., Reg. No., C. 205).

Hab.—St. Vincent Gulf.

Two much damaged ovigerous females are in the collection. The characters given above, together with the figures, suffice to separate this variety.

Family PALAEMONIDAE.

Leander intermedius, Stimpson.

Dredged from "Conqueror," 3-4 fms.

Leander serenus, Heller.

Hab.—Flinders and Pearson Islands; in rock pools.

Apparently no species of *Leander* has been previously noted from South Australia; the two forms recorded above are common.

Leander litoreus, McCulloch.

Hab.—Flinders Island; in rock pools.

Three specimens were taken in company with *L. serenus*. These two species have also been found associated at Glenelg, South Australia; both seem to frequent rock pools rather than the open sea and reefs, as does *L. intermedius*.

Suborder REPTANTIA.

Tribe ANOMURA.

Family CALLIANASSIDAE.

UPOGEBIA (GEBIOPSIS) BOWERBANKII, Miers.

Hab.—Smoky Bay; several small examples.

Family PAGURIDAE.

CLIBANARIUS STRIGIMANUS, White.

Hab.—Flinders Island; in a rock pool.

A large specimen from a *Fusus* shell. Soon after capture this example vacated its retreat and crawled about unprotected. The species was also taken by Sir Joseph Verco, in the Great Australian Bight, many years ago.

PAGURISTES SULCATUS, Baker.

Dredged from "Conqueror," 3-4 fms.

Tribe BRACHYURA.

Family DROMIIDAE.

CRYPTODROMIA OCTODENTATA, Haswell.

A specimen dredged from the "Conqueror" bears a sponge which is eight times the weight of the crustacean. This common species was on several occasions taken by the Federal trawler "Endeavour" in South Australian waters, one female being trawled "Fifteen miles south of St. Francis Isle, South Australia, 30 fms."

The two following Dromiid crabs were also taken by the "Endeavour" at the same locality:—

Dromidiopsis excavata, Stimpson. *Petalomera depressa,* Baker.

Family XANTHIDAE.

PILUMNUS TOMENTOSUS, Latreille.

Dredged from "Conqueror," 3-4 fms.

OZIUS TRUNCATUS, Milne-Edwards.

Flinders Island; under stones on beach.

Family GONEPLACIDAE.

LITOCHEIRA BISPINOSA, Kinahan.

Dredged from "Conqueror," 3-4 fms.

This common little species has been recorded from St. Vincent Gulf by McCulloch.

Family GRAPSIDAE.

LEPTOGRAPSUS VARIEGATUS, Fabricius.

Dredged from "Conqueror," 3-4 fms., and Flinders Island, in rock pools.

Examples from the island are of dark-grey colouration, matching that of the rocks from amongst which they were taken. In a specimen dredged away from shore, the predominant colour is dark red.

BRACHYNOTUS OCTODENTATUS, Milne-Edwards.

Hab.—Pearson and Flinders Islands; plentiful on coasts.

Mr. Waite notes that on Flinders Island "specimens were taken from a well, containing brackish water, used at the camp for the first meal only. The crabs

must have fallen in, and they could not possibly escape. Whether they bred in the well, or whether the numbers are maintained by new arrivals, it is not possible to say."

CYCLOGRAPSUS AUDOUINII, Milne-Edwards.

Dredged from "Conqueror," 3-4 fms., and Flinders Island, under stones.

Family INACHIDAE.

NAXIA AURITA, Latreille.

Dredged from "Conqueror," 3-4 fms.

SCHIZOPHRYS ASPERA, Milne-Edwards.

Dredged from "Conqueror," 3-4 fms.

Family HYMENOSOMATIDAE.

ELAMENA (TRIGONOPLAX) UNGUIFORMIS, De Haan, var. *longirostris*, McCulloch (text fig. 1).

Elamena (Trigonoplax) unguiformis, De Haan, var. *longirostris*, McCull., Rec. Austr. Mus., vii., 1908, p. 59, pl xii., fig. 3; Kemp, Rec. Ind. Mus., xiii., 1917, p. 278.

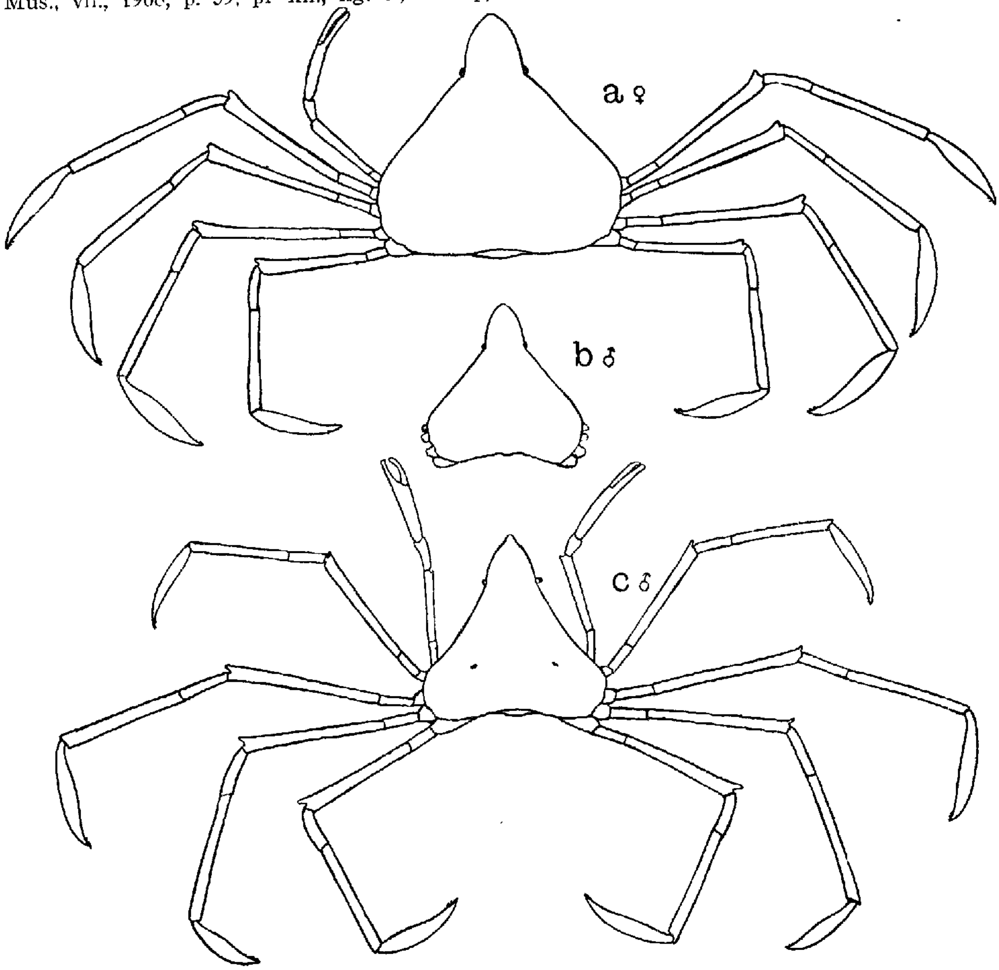


Fig. 1.
Elamena (Trigonoplax) unguiformis, var. *longirostris;* South Australian specimens.

Four males and four females from South Australia differ from the specimen figured by McCulloch in having the antero-lateral margins of the carapace almost straight and the sides of the rostrum evenly convex and converging regularly from base to apex (fig. 1, *a* and *b*). A ninth example has the sides of the carapace a little concave and the margin of the rostrum sinuate, thus more nearly approaching McCulloch's figure. In this last specimen the legs are relatively longer than in the others (fig. 1, *c*).

A single male was dredged from the "Conqueror," 3-4 fms.

Hab.—Victoria: Port Phillip (McCulloch, type loc.). South Australia: St. Vincent Gulf, Kangaroo Island (north coast), and Nuyts Archipelago.

ISOPODA.

Tribe FLABELLIFERA.

Family CIROLANIDAE.

Cirolana wood jonesi, n. sp.

Pl. v., text fig. 2.

Form moderately slender, very convex; a little variable in width, the greatest breadth two and two-thirds to almost three in the length.

Head wider than long, its medial length a little less than that of first thoracic segment. Eyes black, in lateral view longer than deep; upper margin almost straight; facets rather large, six to seven in a longitudinal series. First antennae extending to about middle of ultimate peduncular joint of second antennae; second antennae with third, fourth, and fifth peduncular articles subequal in length; flagellum variable in length, reaching back nearly to posterior margin of first thoracic segment, or a little beyond it, usually composed of from eighteen to twenty articles, but occasionally as many as twenty-seven are present. Frontal lamina about four times longer than greatest width, distinctly widened at anterior third, narrowed behind this, and again slightly dilated at posterior end; the front end not visible from above. Clypeus less than half as long as frontal lamina, and considerably shorter than the labrum; convex, with lateral margins elevated. Maxilliped with seven articles. Mandible with the three teeth of cutting part usually very distinct; occasionally the middle tooth is obsolete; palp composed of three articles. First thoracic segment much longer than any of the others, which are more or less subequal in length.

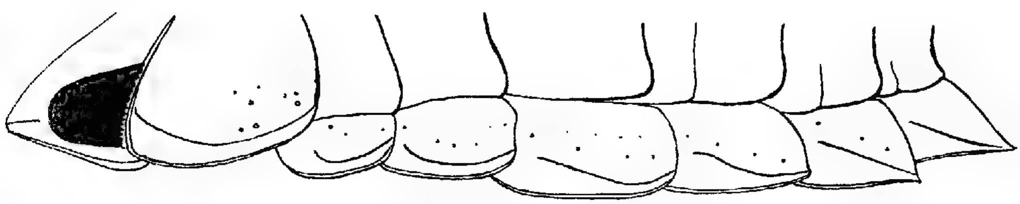


Fig. 2.

Thoracic epimera of *Cirolana wood jonesi.*

Epimera of second to seventh segments each with an oblique furrow (in addition to the obscure submarginal furrow) arising near the infero-posterior angle and curving forwards towards (but not reaching to) the middle of the posterior margin of the preceding epimeron; the furrow of the seventh epimeron does not reach to the posterior angle in most examples, but is occasionally obscurely continued to it. The second joint of the legs becomes increasingly expanded posteriorly, that of the first leg being barely more than three-eights as wide

as the seventh, and widest. Seventh leg with the second joint much expanded, its greatest width being almost three-fourths of the length, and with lateral margins and inferior median ridge set with long, plumose hairs; third joint longer than any of the following joints; fourth slightly longer than fifth and a little shorter than the sixth joint. Lateral margins of telsonic segment convex, without apparent spines. Uropods moderately slender; endopod about two and one-third times longer than wide, reaching slightly beyond termination of abdomen, not notched near end of outer margin; exopod shorter than endopod, four times longer than broad.

Colour (during life), whitish, more or less suffused with red.

Length (largest example), 18 mm. (S. Austr. Mus., Reg. No., C. 228).

Hab. -South Australia: Elliston (Nuyts Archipelago Exped.), St. Vincent Gulf (H. Collyer and others), Beachport, 3-4 fms. (H. M. Hale).

The above description is based upon a series taken from the body cavity of a Port Jackson shark *(Heterodontus phillipi)* collected by Mr. Collyer; there are also before me examples taken from a seven-gilled shark *(Notidanus indicus)*. The Elliston specimens are mostly of small size and were captured on bait when line fishing. The species was dredged at Beachport and found buried in wet sand at the water's edge near the Outer Harbour.

As mentioned above, the flagellum of the second antennae varies in length and in the number of articles of which it is composed; the variation is not according to age. *C. wood jonesi* somewhat resembles *C. borealis,* Lilljeborg, and is still more closely allied to *C. gallica,* Hansen, from France. It may be distinguished from the last-named species by the straighter upper margin of the eye and by the less oblique furrows of the epimera of the fourth to sixth thoracic segments; in *C. gallica* each of these furrows is directed forwards and upwards towards the middle of the thoracic segment above. The presence of the oblique furrows at once separates *C. wood jonesi* from *C. borealis.*

Of the Australian species it, in some respects, approaches *C. tenuistylis,* Miers,[1] which is rather briefly described; according to Miers' figure, however, the eye of that species is subcircular in lateral view, the frontal lamina is of different shape, and there are no oblique furrows on the thoracic epimera.

Family SEROLIDAE.

The following species were dredged "off St. Francis Island, 6-13 fms.," by Sir Joseph Verco, and were recorded by Dr. Chas. Chilton [2] :—*Serolis tuberculata,* Grube; *S. longicaudatus,* Beddard; *S. minuta,* Beddard.

EXPLANATION OF PLATES IV. AND V.

PLATE IV.

Fig. 1. *Pandalus (Parapandalus) leptorhynchus;* female, St. Vincent Gulf, (enlarged 2½ diams.).
„ 2. Dorsal view of cephalothorax of same (enlarged 5 diams.).
„ 3. Carapace of *P. leptorhynchus,* var.; female, Nuyts Archipelago (enlarged 3 diams.).
„ 4. Dorsal view of cephalathorax of same (enlarged 5 diams.).
„ 5. Second leg of *P. leptorhynchus* (enlarged 14 diams.).
„ 6. *P. leptorhynchus,* var. *gibber;* female, St. Vincent Gulf (enlarged 3 diams.).
„ 7. Second leg of same (enlarged 14 diams.).

(1) Miers, Zool., "Alert," 1884, p. 303, pl. xxxiii., fig. *b.*

(2) Chilton, Trans. Roy. Soc. S. Austr., xli., 1917, pp. 393-397.

Plate V.

Cirolana wood jonesi.

Fig. 1. Lateral view.
„ 2. Dorsal view.
„ 3. Ventral view of head (maxillipeds removed).
„ 4. Front view of same to show frontal lamina.
„ 5. First antenna.
„ 6. Second antenna.
„ 7. Mandible.
„ 8. Distal part of molar process of mandible.
„ 9. First maxilla.
„ 10. Second maxilla.
„ 11. Maxilliped.
„ 12. First leg.
„ 13. Seventh leg.
„ 14. Telsonic segment and uropods.
„ 15. Right pleopod of second pair of male.

Figs. 1 and 2, enlarged 4 diams.; fig. 8, enlarged 100 diams.; figs. 12, 13, and 15, enlarged 10 diams.; remainder of figs., enlarged 20 diams.

AN ACCOUNT OF A HITHERTO UNRECORDED TYPE OF ABORIGINAL STONE OBJECT.

By T. D. Campbell, D.D.Sc.

[Read June 12, 1924.]

The following notes contain a short description of what appears to be a hitherto unrecorded type of native stone object. Briefly, the circumstances of the discovery of these objects are as follow;—A very large native camping ground is situated in an area of blown sand dunes where Pedler's Creek reaches the coast, three miles south of Port Noarlunga, or about 24 miles from Adelaide. This site is an old one, and was probably occupied by natives belonging to what is popularly referred to as the Adelaide Tribe, but which is, according to J. J. East, more correctly known as the Winnaynie Tribe. The old camp site has proved a more or less profitable hunting ground for collectors of native stone implements for some considerable time. On a visit to this spot in March of this year, while searching for worked flakes, the writer's attention was attracted to a piece of slatey material, which appeared to have an artificial contour and unusual markings on it. The object had been broken, but the fragment was sufficiently complete to indicate that when intact, it was roughly kidney-shaped in outline, and the surfaces of the fragment were covered with incised markings, obviously a piece of aboriginal handiwork. A continued search was rewarded by the finding of another example of the same type. The lateness of the hour prevented further search on that occasion. A subsequent brief visit to the same site produced no further finds.

In the early part of April, the site was again visited in order to carry out a more careful and systematic search, and the writer is indebted to his friends, Messrs. A. Williamson and P. S. Hossfeld, for their enthusiastic assistance on the third examination of the site. Garden rakes were carefully used for disturbing the sand in the hope of revealing stones that had been buried in the drift. The search resulted in Mr. Hossfeld finding another undoubted example of the same type of object, and the writer was fortunate enough to recover three small fragments belonging to the broken specimen of his initial find.

A general description of this type is as follows:—All three examples have been fashioned from thin pieces of greenish-grey slate[1] about 5 mm. thick; all are roughly reniform in outline and very similar in dimensions. They show obvious indications of having been shaped into a definite form and rubbed to a requisite smoothness. Each possesses a large notch on its lower border which was deliberately cut out, as is shown by the smoothing down of, and remaining scratches adjacent to, the edge of the notch. All have incised markings in varying degree of perfection and complication. Two, apparently either newer or less weathered specimens, still bear remains of a coating of red ochre. A detailed description of each example is here given.

No. 1 (fig. 1).—Fragment constituting a little more than half of what had been a rather well-contoured and symmetrical object. Smaller fragments found subsequently are also shown in position; the position of the detached portion is hypothetical, but it has been arrived at by a careful comparison of its

[1] Mr. P. Hossfeld informs me that these specimens are probably of phyllitic slate, with their surfaces sand polished, this material being fairly common in the Mount Lofty Ranges.

thickness relative to that of the major portion. Horizontal diameter, 92 mm.; vertical diameter, 60 mm. (estimated). Periphery well rounded and smoothed. Surface A presents incised markings thus: commencing at each outer corner are small cuts, about 3 mm. long, at irregular intervals around the periphery; the main area shows one complete and two incomplete rows of incised vertical marks, varying from 3 to 6 mm. Other faint irregularly-placed incisions appear to bear little relation to the inscriptive markings and were probably caused in smoothing down the surface with some harder material. Along the border of the large notch are long scratches, undoubtedly made during the fashioning of the notch. This surface, and also the surface of the fractured edge, bear a

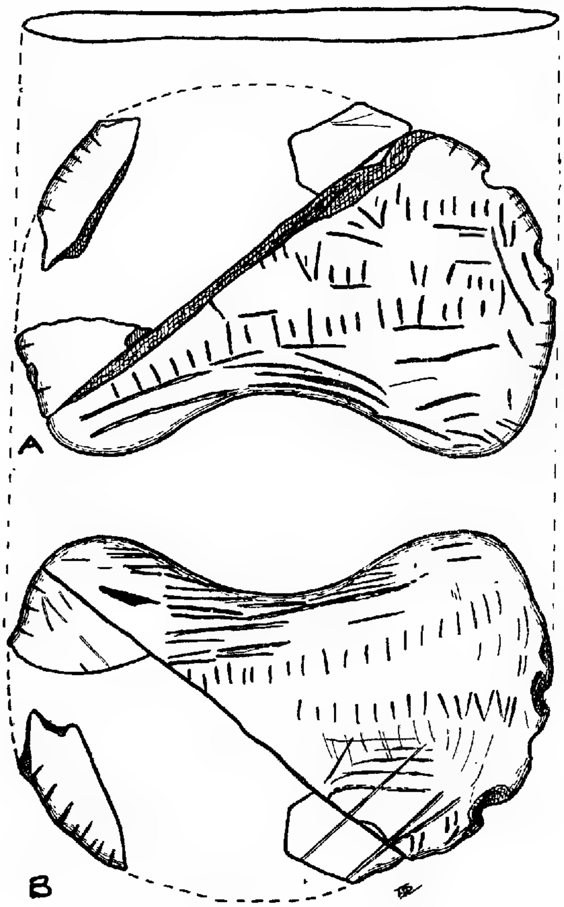


Fig. 1. Specimen No. 1. ×¾.

"patinated" appearance, no doubt due to weather and the action of blown sand, and therefore not a true patina; this polishing action has tended to the partial obliteration of the surface markings. Surface B also presents the peripheral markings and portions of two rows of vertical incisions. Well-marked scratches on the border of the notch are probably incidental to its formation. Near the border, opposite to the notch, are several rather deeply-cut lines in a slanting position, and two pairs of small, well-marked, vertical cuts adjacent to them. This surface has obviously not been exposed to weather so much as has Surface A.

No. 2 (fig. 2).—This example is complete and is more nearly circular in outline than No. 1, but it has not the basal notch so well developed; also its border has not been finished so smoothly, for in places it plainly shows the chipping carried out to obtain the desired outline. In size it is 92 mm. in its horizontal and 66 mm. in its vertical diameter. Both its surfaces bear faint traces of red ochre with which they had been rubbed. Surface A presents two strikingly well-cut "arrow" figures which "point" in a slanting direction downwards to the left side of the notch; the upper one measures 14 mm. and the lower 9 mm. in length. Near the left side are two slightly converging vertical lines about 10 mm. in length. On the lower part of the surface are a

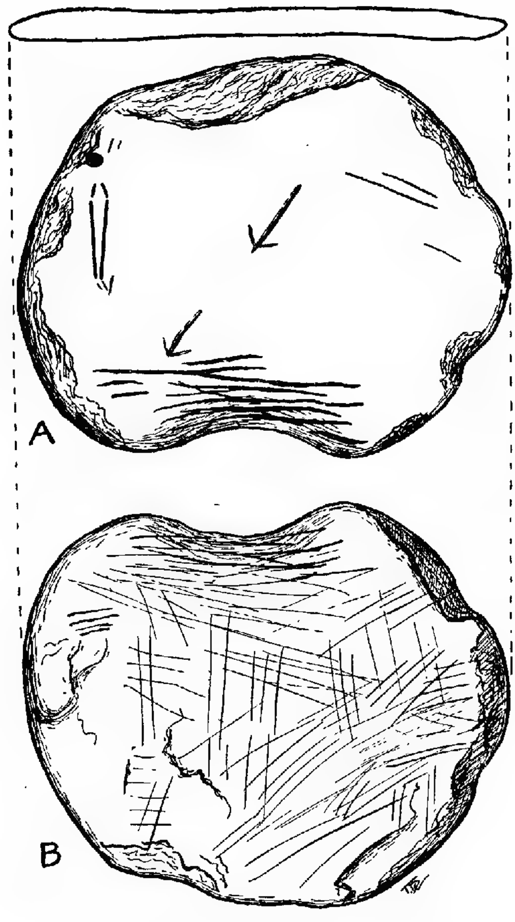


Fig. 2. Specimen No. 2. ×$\frac{3}{4}$.

number of more or less parallel horizontal lines which merge with the scratches associated with the notch formation. Red ochre is present, especially on the left side of this surface. Surface B is rougher than A, and is covered with many scratches occurring in a variety of directions; these are probably due either to a haphazard decoration of the whole surface or to an attempt to smooth down the surface with some harder piece of stone. The whole surface bears remains of a red ochreous coating.

No. 3 (fig. 3).—This specimen exhibits poorer execution than the other examples. A small fragment is missing from one side of the notch, the notch

itself being broad and shallow. In size this specimen measures 90 mm. in horizontal and 61 mm. in vertical diameter. Both surfaces present "steps" of varying size at their periphery, caused by the shaping up of the object.

Surface A, on its right side, has two deeply-incised vertical lines about 20 mm. in length, and near them, two shorter and fainter lines; also nearer the edge on the same side are two groups, one of four and the other of three lines. On the left side near the fractured edge are a number of irregular scratches, while just above the notch are three broad but scarcely discernible cuts. The border of the notch shows many fine scratches. A large shallow

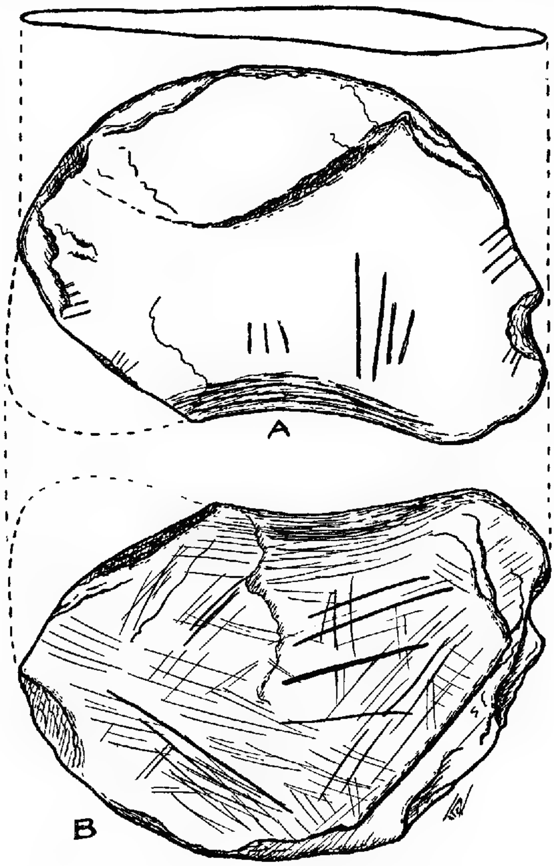


Fig. 3. Specimen No. 3. ×⅘.

"step" occupies most of the upper part of this surface. Surface B presents deep "stepping" on its lower and right borders, due to attempts at shaping the object, and practically the whole surface is irregularly scored in a manner similar to Surface B of No. 2. It also bears the remains of an ochreous coating.

Probable Purpose of the Objects and Significance of their Markings.

As the accounts of the natives who occupied the southern parts of this State contain but little information concerning material culture, not much assistance is forthcoming from the literature. Therefore, any suggestion as to the purpose of these objects must be based on conjecture and on analogy derived from a study of the more northerly tribes.

The possibility of their being a form of implement can be readily dismissed, as they are of a material and shape which would serve no utilitarian purpose. Of the smaller types of objects which bear scratches and markings, there are message sticks, and the sacred and ceremonial objects. Those for the conveyance of messages apparently always took the form of a piece of wood, and probably have no relation whatsoever to these reniform slates. On the other hand, considering them as a type of ceremonial or sacred object, we may find some evidence which points to such being their correct designation.

Comparison may be made with the stone Churinga or totemic objects of the Central tribes of this continent; the parallel features are as follow: they are made from a thin palette of stone, and present obvious indications of having been shaped into a definite form; they have incised markings and show the application of red ochre.

As regards the form of the present specimens, they are thinned down and shaped to a definite outline, as are the stone Churinga of the Central tribes, and although the reniform contour of the former differs from the usual oval or pear shape of the latter, this does not totally destroy their likeness, but renders it the more interesting. In the objects from Central Australia, the incisions take the form of quite ornate designs, executed chiefly in concentric figures and curved lines, or groups of straight lines, or markings imitative of natural objects; while in the present type the incised decoration of the stones is comparatively crude and asymmetrical. However, there seem to be reasons for considering material culture at a lower standing among the natives in the southern parts of the State than among those of the central and northern areas of the continent; and this, together with the possibility of the totemic system being relatively less advanced among the former, may account for the comparative crudity of the workmanship. The coating of these objects with red ochre affords a parallel with the more northerly specimens on which, particularly the flat stone Churinga, its occurrence is fairly frequent.

The nature of the incised markings shows some impressive points of similarity. Probably the most striking and readily interpretable are the "arrow" figures on Surface A of No. 2. These are identical with the figures present on some Churingas which are attributed to natives of an emu totem in the Central tribes; these "arrow" figures represent the footprints of the emu, or some animal like the kangaroo or rat kangaroo. Therefore it seems not unlikely that Specimen No. 2 was a sacred object of some native belonging to a kangaroo or emu totem in this southern vicinity. Again, the small peripheral markings, so well shown on the border of Specimen No. 1, form a very similar method of decoration to that appearing on some of the Churingas of the Central tribes. The rows of vertical lines and the lack of definition and figure design in other of the markings on our present examples present a problem incapable of easy interpretation. However, crude and obscure as these markings may appear to us, they no doubt had a very definite and important meaning for those who were conversant with these objects. The general distribution and varied direction of the scratches on Surface B of both Nos. 2 and 3 seem to suggest that they formed a general decorative scheme of the whole surface without having any special meaning.

Further finds and more intensive comparative study would no doubt completely solve the problem as to the nature and purpose of these incised slates. For the present, the recording of their occurrence seems to be justified, in that it at least adds a small contribution to our present sparse fund of information on the material culture of the natives who inhabited the southern parts of this State, and also places on record the finding of what is probably another form of ceremonial object.

POUCH EMBRYOS OF MARSUPIALS.

No. 8.—DENDROLAGUS MATSCHIEI.

By F. Wood Jones, D.Sc., F.Z.S.,
Professor of Anatomy in the University of Adelaide.

[Read June 12, 1924.]

For the opportunity of examining the pouch embryo of this rare and interesting tree-wallaby I am indebted to Mr. A. S. Le Soüef, of Taronga Park, who very kindly placed at my disposal a specimen in an extremely good state of preservation. Since the genus *Dendrolagus* presents so many interesting problems in phylogenetic readaptation, the examination of the young animal is a matter of some importance. Two alternatives might be considered possible. We might discover that the young animal was more phalangerine in its early stages and that its macropine characters were merely superficial, or we might find that the earlier stages showed it to be truly macropine and its phalangerine characters were merely convergent. The animal might possibly be a macropus-like phalanger, or a phalanger-like macropus. It might be an old-established arboreal animal convergently somewhat like a kangaroo, or it might be a real

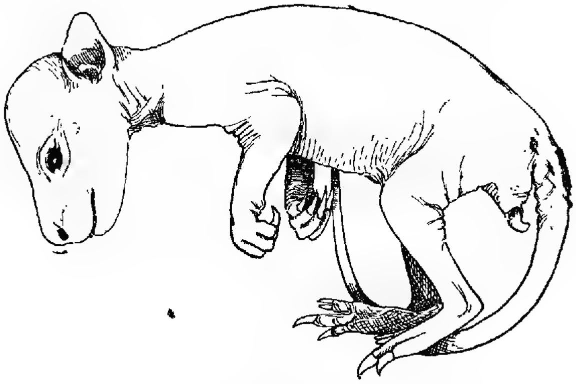


Fig. 1.
Dendrolagus matschiei.
General form and proportions of pouch embryo. Half natural size.

terrestrial kangaroo reacquiring arboreal habits after a terrestrial apprenticeship. The specimen examined is a male, 125 mm. R.V. measurement, with a total head and body length of 195 mm., and a tail length of 109 mm. Although hair is just beginning to appear upon the general surface of the body, it is, unfortunately, not sufficiently developed to permit of any ordered disposition of hair tracts being detected. Such sensory vibrissae as are developed are fully erupted and pigmented.

The general form of the animal is very remarkable (see fig. 1), for the mixture of phalangerine proportions and macropine structure results in the production of a very strange type of animal. The excessively large fore limbs are very different in appearance from the slender and under-developed appendages

of the typical macropines. The hind limbs are even more remarkable, for with the general macropine outline of structure, they are extremely short and stout and very unlike the typical elongated legs and feet of the normal kangaroos. The general build appears to be extremely clumsy, and were the habits of the adult to be unknown, the naked pouch young would present a very real problem.

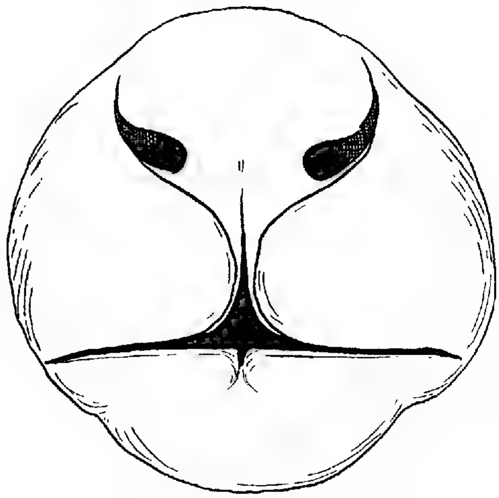


Fig. 2.
Dendrolagus matschiei.
The form of the rhinarium. Four times natural size.

Fig. 3.
Dendrolagus matschiei.
Characters of the auricle of the left side. Four times natural size.

The head is, in all its main features, typical of the normal kangaroos. The rhinarium (see fig. 2) is not yet completely differentiated, for it is impossible to determine from this young animal exactly what area of the muzzle will be hairless and what hairy. In its form, however, the rhinarium is typically macropine; so, too, is the very definite mid-mandibular cleft which here, though not very deep, is perfectly clearly defined.

Fig. 4.
Dendrolagus matschiei.
Outline of the head to show the disposition of the facial vibrissae. Natural size.

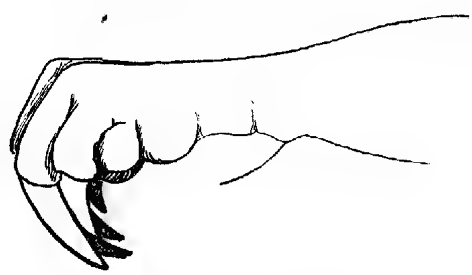


Fig. 5.
Dendrolagus matschiei.
The well-developed ulnar carpal papilla and single vibrissa. Twice natural size.

In the auricle, the processes antihelicis is in the form usual in the kangaroos (see fig. 3), and it presents no outstanding features by which it could be distinguished from that of *M. agilis* or *M. eugenii* embryos as the same stage of development. The processus is well defined but not greatly raised; and deeper in the auricle is a second, larger, but more irregular, derivative of the antihelix.

The vibrissae and papillae are not particularly well developed. Upon the face (see fig. 4) the supraorbital papilla gives rise to four curved vibrissae; the genal papilla is partially subdivided into an upper papilla giving rise to two vibrissae and a lower papilla giving rise to only one.

The mysticial set is poorly developed, the papillae being better developed than the vibrissae, which spring from them. They are arranged, in this specimen, in four rows, with the recognisable papillae in the order 1, 3, 3, 4. Apart from the mysticial vibrissae proper, the upper lip is fringed by short, curved, and somewhat stiff hairs. In the same way, the point of the chin gives rise

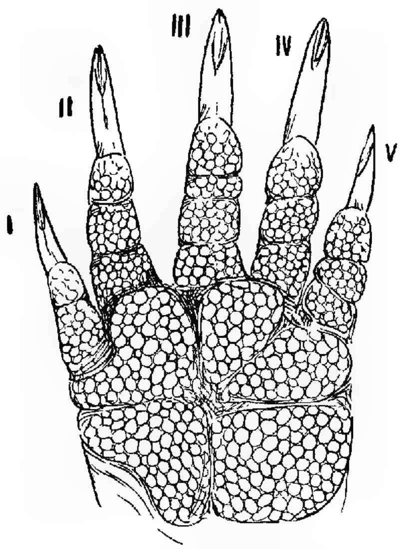


Fig. 6.
Dendrolagus matschiei.
Palmar surface of left manus. Three times natural size.

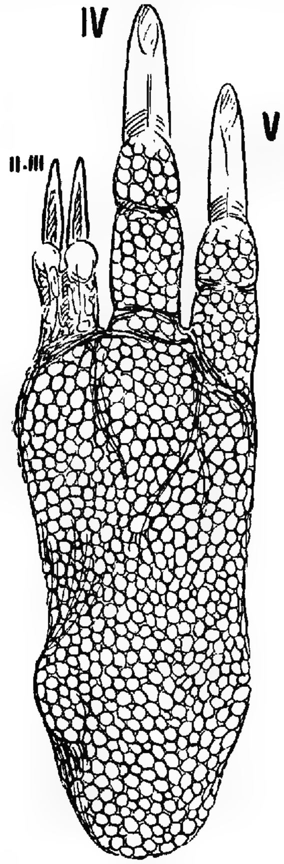


Fig. 7.
Dendrolagus matschiei.
Plantar surface of left pes. Three times natural size.

to numerous curved bristle hairs which do not arise in connection with papillae. In addition, the lower jaw carries two well-defined papillae upon either side of the middle line. These two low mandibular papillae give rise to two vibrissae each, and the hinder is about as far distal as the angle of the mouth. The ulnar carpal papilla is well developed and, as in the typical wallabies, only a single vibrissa springs from it (see fig. 5). The manus is at once distinguished for its relatively enormous size and for the sturdiness of the limb upon which it is borne. The claws are long and robust and are all about equally curved. The digits are without defined apical pads, and are coarsely granulated over the whole

of their palmar surface. The palm is evenly granulated. The outlines of five ill-defined pads are distinguishable and the pads present are interdigital pads 1 and 2 fused, and 3 and 4 separate, with large thenar and hypothenar pads. The digital formula is $3 > 4 > 2 > 5 > 1$, the small size of the first digit being a notable feature (see fig. 6). The pes is very remarkable and agrees in most respects with that of the adult of *D. ursinus* figured by Bensley. The shortness of its digits is particularly striking and the total length of the pes is only about three times its breadth, whereas, in an embryo of *Macropus agilis* of the same size the proportion is eight to one. The first digit is entirely wanting, the syndactylous elements are well developed, the typically dominant 4th and 5th digits being very short when judged by normal macropine standards.

The claws of the 4th and 5th digits are somewhat curved, but it is to be noted that their curvature does not exceed that typical of those of the terrestrial Macropodidae at this stage. The 4th and 5th digits are coarsely granulated. The curious padded sole has no well-defined pads, but presents the appearance of a cushion, studded over with circular elevated granulations (see fig. 7).

It is, therefore, clear that *Dendrolagus,* although it has somewhat phalangerine proportions, has typical macropine structure. Its phylogenetic terrestrial apprenticeship has shaped and modified all its parts, its present arboreal radiation is merely altering the relative proportions of these modified parts. It certainly shows how the best arboreal use may be made of terrestrial saltatory members, but it also demonstrates how impossible it is to re-beget a primitive arboreal phalanger manus and pes from those members when once they have modified their primitive structure in harmony with the demands of the specialised function of terrestrial leaping.

In the adult *Dendrolagus* the claws of the dominant digits of the pes are curved, thus affording a great distinction from the almost straight claws of the typical wallabies; but this curvature is merely a retention of the condition which is present in the young of all wallabies.

It is rather remarkable that the pollex is no better, but even rather worse, developed than it is in the typical kangaroos. There seems to be no recall for a pollex or hallux that has undergone phylogenetic reduction.

ON THE DISCOVERY OF SUPPOSED ABORIGINAL REMAINS NEAR CORNWALL, TASMANIA.

By Robert Pulleine, M.B., M.Ch.

[Read June 12, 1924.]

Plates VI. to IX.

In the British Museum there is an object which is figured in Ling Roth's "Aborigines of Tasmania," Ed. 2, p. 64, and there described as a "Tasmanian skin bag supposed to contain ashes of human bones." What is undoubtedly another example of a similar object was found near Cornwall by a man, named Bradbury, early in 1920.

The circumstances of the discovery were as follows:—Mr. Bradbury was walking along the base of the escarpment of the Mount Nicholas Range, near the village of Cornwall, when he found a deep cleft beneath an overhanging sandstone rock. On the floor of the cleft he discovered a skin bag covered with stringy bark and held down by two stones. On examining the contents of the bag he found it to contain two dried hands, five bones, two shells, and some skin and other matter which resembled dried viscera. Bradbury took the bag and contents to the Police Officer, at St. Mary's, and an inquest was held on them at the Court House at Fingal, where the medical witness testified that they were human remains of old but uncertain age.

In August, 1923, I was asked to inspect them in Melbourne, whither they had been removed, and in November, 1923, I took charge of them, intending to investigate the circumstances later. In April, 1924, I was able to locate Mr. Bradbury, the discoverer of the objects, at his home at St. Mary's, and together we motored up the mountain side to the village of Cornwall and ascended the mountain to the escarpment, following which we reached the cleft where the discovery was made.

The Locality.

The Mount Nicholas Range consists of coal-measures (Trias Jura) on a base of Permo-Carboniferous age, the coal being overlaid by a peculiar felspathoid sandstone of the same age, and this, again, capped by diabase (? cretaceous). This range is close to the town of St. Mary's, within a few miles of the east coast, and lies in the triangle formed by the South Esk and Break o' Day rivers. The range is thickly timbered with *Eucalyptus* and there is a dense undergrowth in which *Pomaderris*, of two or three species, predominates.

To reach the locality of the discovery we climbed from the village on to the mine track, and walking westward along the tram lines went upwards through the bush until the sandstone escarpment was reached. Climbing along this, to the westward, the spot was pointed out by Mr. Bradbury. Here I found the stones and bark on the floor of the ledge where they had been left when the bag and contents were removed in 1923.

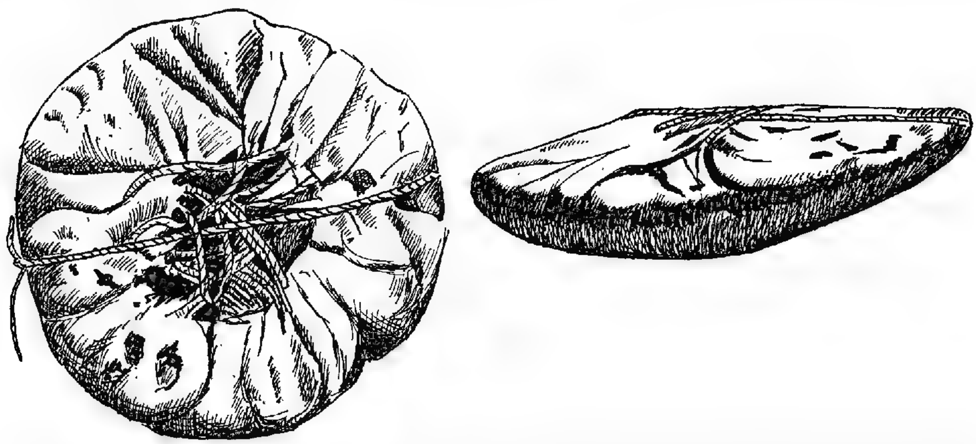
The photograph, reproduced as pl. vi., was taken next morning, and gives a good idea of the site. As seen from the place from which the photograph was taken, the essential points are a sandstone roof, overhanging the cleft by about 6 feet, and a cleft in the rock. The cleft itself, about 4 feet long, as measured on the floor, has a height of less than a foot in front, and a depth of about 2 feet 6 inches at the inner extremity where the roof and floor meet. The floor was composed of perfectly dry rubbly-sandstone on which the bark and

stones were resting, and below the front edge the cliff dropped vertically for 4 feet 6 inches to a ledge 2 feet wide, below which the sandstone formed a vertical wall, 12 feet high, terminating on the wooded slope below the base of the escarpment.

These details are given to show the peculiar conditions which must have led to the preservation of the objects in question:—1. A perfectly dry, deep cleft, facing southwards, overhung several feet by a heavy sandstone roof. 2. Its protection from below by a high, vertical, sandstone wall. The first condition would ensure freedom from moisture in all weathers, the second absolute protection from marauding animals; besides these, and most important of all, protection from bush fires was assured.

The Bag and Contents.

The Bag.—This is composed of a vegetable substance, origin unknown, which superficially has the appearance of partially tanned leather. Professor Robertson, of the Adelaide University, on the basis of the absence of any protein reaction, states that it cannot be of leather or any other animal tissue. The largest fragment of the bag is 14×9 inches, and from the arrangement of the slits at the side is, probably, only a half, or a third, of its original size. Two other pieces of the same material, much curled up, may be assumed to be part of the original bag.



Tasmanian skin bag, top and side view, supposed to contain ashes of human bones. The flat appearance is probably due to packing. Diam., 7½ inches. Brit. Mus. Redrawn from Ling Roth's "Aborigines of Tasmania," p. 64.

There is a ragged hole, 2½ inches in diameter, 2 inches from the margin of the large piece, and on the margin are the holes formed by a series of slits, the number and extent of which are well shown in the photograph. None of the string or cord used for drawing the bag together was recovered.

The Hands.—The right hand, slender, measures 6½ inches from the carpus to the end of the middle finger, the palm and dorsum are covered with skin, some of which is still black; a mass of flexor tendons is still attached. The two terminal joints of the little finger are missing.

The left hand has three strips of the skin of the arm removed with it, which are attached to the base of the thumb. A long piece of skin, with the two terminal phalanges of the little finger, was separate from the rest and is shown *in situ* in the plate but associated with the wrong hand.

On both sides the carpal bones were removed with the hands and remain *in situ.*

The skin covering the hands is, in part, still pigmented, and a histological examination by Mr. William Fuller, Lecturer on Histology at the Adelaide Medical School, shows that the pigment situated in the deep cells of the Malpighian layer occurs as in other coloured races. The nails are missing and the skin, in part, removed by insect activity. On the whole, however, the preservation is fairly good and the hands are those of an adult.

The Bones.—These are the right and left humerus, the right radius, and the right and left ulna.

As seen in the plate, portions of periosteum, capsular ligaments, and interossens membranes are still attached to the various bones, and the dried cartilage of the articular surface is still *in situ* and in a relatively fresh condition. Apart from some cuts on the cartilage on the heads of both humeri there are no marks on any of the bones.

The Shells.—Two valves, not paired, of *Pectunculus flabellatus,* a common bivalve of the Eastern Tasmanian littoral.

Other Contents.—A mass of tissues in a shrunken condition and much deteriorated by insect activity, appear to have been originally viscera. Nothing can with certainty be recognised, although two bodies have the appearance of dried kidneys.

COMMENT.

Although the package containing the bones, etc., is now in a fragmentary condition, the discoverer assured me that when he found it, it formed a bag. The contents were arranged as follows:—One hand on top, then the bones, etc., and the second hand at the bottom.

We may assume that the handling it underwent from curious persons and in the course of a legal process was too much for its friable condition. We may, however, I think, be sure that the British Museum specimen and that in question are of the same nature. A third, probably, is still in the collection of the Royal College of Surgeons, as it formed part of the Barnard Davis collection acquired by that institution. This is referred to in the Supplement to the "Thesaurus Craniorium" (1494, p. 65): "The two femora and two ulnae with dried soft parts tied up in a little bag made of bass." Other specimens in this collection bear witness to the extent to which the wearing of human bones was carried, *vide:* 1487, the calvarium of a child; 1488, 1489, 1490, lower jaws provided with strings to suspend them round the neck; 1491, 1492, two specimens of tibiae prepared for suspension in the same manner; and 1493, a left radius prepared in the same manner for the same purpose. All these relics were collected by George Augustus Robinson, Protector of Aborigines, and were purchased after his decease.

Bonwick, in his "Daily Life of the Tasmanians," p. 10, says:—"So many skulls and limb bones were taken by the poor natives when they were exiled to the Straits (Flinders Island) that Captain Bateman told me that when he had forty with him in his vessel they had quite a bushel of old bones among them."

In Stokes' "Discoveries in Australia," vol. 2, p. 466, we read:—"When being conveyed to Flinders Island, Mr. Bateman, commanding the colonial brig 'Tamar,' described them as reconciled to their fate, though during the whole passage they sat on the vessel's bulwark, shaking little bags of human bones, apparently as a charm against the danger to which they felt exposed."

Ling Roth, "Aborigines of Tasmania," 2nd Ed., pp. 64 and 65, gives several extracts from Tasmanian authors referring to this matter.

The Tasmanian habit of wearing human bones as remembrances is exactly paralleled in the Andaman Islands: see Barnard Davis, "Supplement to Thesaurus Craniorium," p. 66:—1552, calvarium; 1574, adult lower jaw; 1575, adult lower jaw; 1762, prepared calvarium; all prepared with native cord to hang round the neck.

Davis remarks, *loc. cit.*, p. 67:—"These very curious objects worn by the Mincopies may really be said to be repetitions of the relics worn by the Tasmanian tribes described in a former page (1487-1493); there is no difference of any importance between them. In the Tasmanian maxillae the harder cord made of sinew is wrapped closely from one end of the jaw to the other. The Mincopies have been contented with securing the relic on each horizontal ramus by a short wrapping of vegetable cord, and they have, in addition, joined the strings of beads both to the calvarium and the jaw."

In consequence of the difference of the mode of attachment in the Tasmanian relics, when worn, the chin hangs downwards; in those of the Mincopies, the condyles hang downwards.

The finding of the hands in the parcel under consideration is the point of unique interest, and it is certain that if the discovery had been made on the Eastern Victorian side of Bass Strait, they would have been identified as the Bret Bret of the Kurnai. Whether dried hands were used as objects of magic amongst the Tasmanians we have no information, so it cannot be proved one way or the other.

Finally, it is of interest to note that a tribe in the Central Division of Papua wears dried hands either as mementos or for magical purposes, *vide* "Patrolling in Papua," by W. R. Humphries, A.R.M., with an Introduction by J. H. P. Murray, Lieutenant-Governor and Chief Judicial Officer of Papua, 1923. On p. 144 we read as follows:—"Arrived at village of Dunai-ia with Chief Kewawi. Some of them I noticed had thumb nails 3 and 4 inches long, hard as wood and curved like the toe of a Cassowary. I also noticed some of the men and women were wearing human hand and leg bones, and I tried to learn the significance of this custom, but on this point they were reticent. I understand though that the hands are dried by continued exposure to the sun, that no preservatives are used."

DESCRIPTION OF PLATES VI. TO IX.

PLATE VI.

Sandstone escarpment of Mount Nicholas Range, showing observer with hand near spot where remains were discovered. Note overhanging rock with deep cleft and dense surrounding forest.

PLATE VII.

The remains of the bag, 14×9 in., showing the slits for lacing. Compare with text figure.

PLATE VIII.

The hands. Note that by error the long strip of skin to which are attached the terminal phalanges of the little finger is shown on the wrong hand. Below are two valves of *Pectunculus*.

PLATE IX.

The arm bones. Right and left humerus; right radius; right and left ulna.

THE ECOLOGY OF THE EUCALYPTUS FORESTS OF THE MOUNT LOFTY RANGES (ADELAIDE DISTRICT), SOUTH AUSTRALIA.

By R. S. Adamson, M.A., B.Sc., Professor of Botany in the University of Cape Town, and

T. G. B. Osborn, D.Sc., Professor of Botany in the University of Adelaide.

[Read November 8, 1923.]

Plates X. to XX.

Contents.

I. INTRODUCTION.

The present paper is the result of our joint study of the ecology of the Mount Lofty Ranges during July-December, 1922, which was based upon the observations of one of us (T. G. B. O.) extending over a number of years

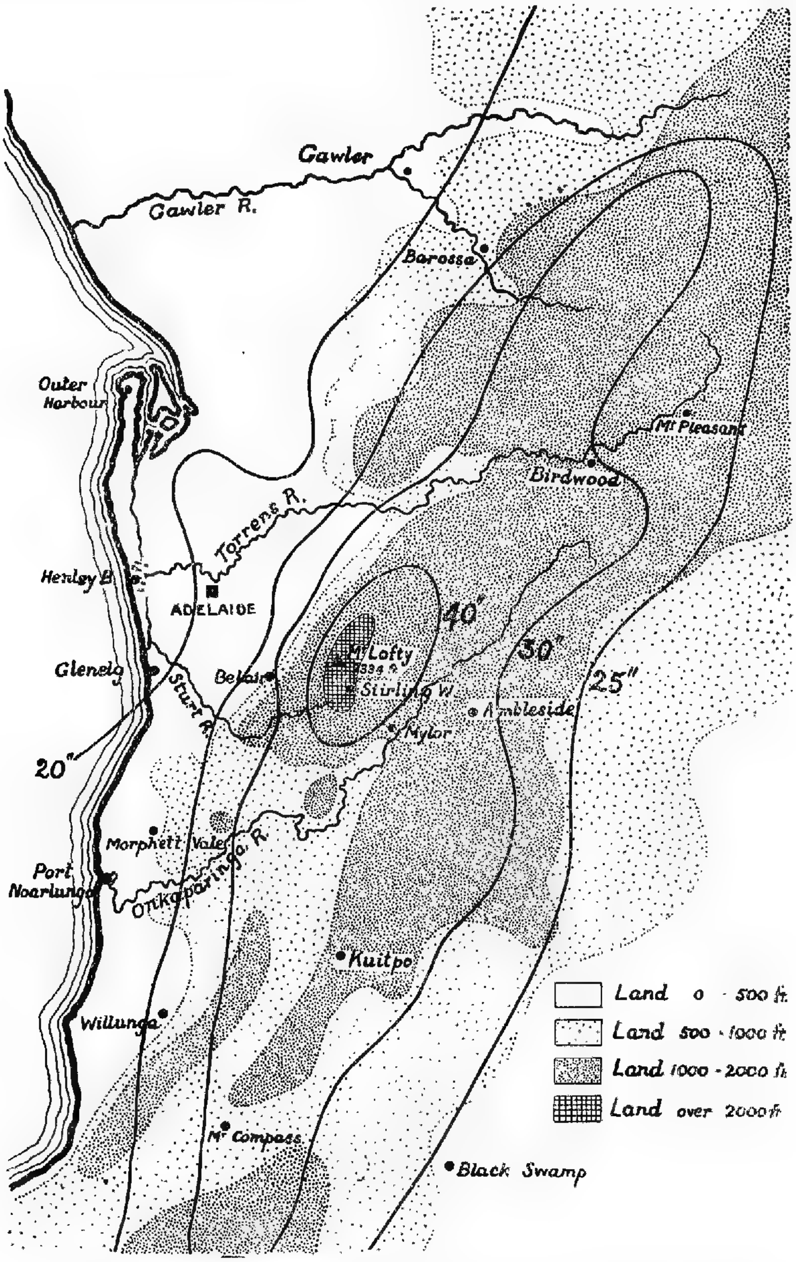


Fig. 1.

Diagrammatic sketch map of the Adelaide area showing isohyets and contours. Based on the rainfall map of South Australia issued by the Commonwealth Meteorological Bureau and a map issued in 1917 by the South Australian Dept. of Mines. True contour lines would be very irregular, especially for land over 2,000 feet.

previously. The district more especially considered is that lying within a 30-mile radius of Adelaide, but we have not limited ourselves to a consideration of that area when a knowledge of the vegetation in other parts of South Australia has been helpful for comparison.

It would not be possible to mention by name all those to whom we are indebted, jointly or severally, for hospitality or assistance by motor transport or in other ways during our work. Without such generous help the work could not have been accomplished, and we offer to all our sincere thanks. Finally, we wish to express our gratitude to the Royal Society of London for a grant towards the expenses of one of us (R. S. A.) in the field during a visit to Australia.

II. TOPOGRAPHIC AND PHYSIOGRAPHIC.

Adelaide stands on a comparatively level plain some six miles from the west coast of Gulf St. Vincent. Inland, to the east of the city, the Mount Lofty Range rises with rather steep slopes to a general height of about 1,500 feet, Mount Lofty, 2,334 feet, being the highest point (fig. 1). While it is possible to speak of a western face to the Mount Lofty Range near Adelaide, on the eastern side the summit generally extends as an elevated plateau which has a gradual fall towards the Murray River. Howchin, in a valuable series of papers (1910, 1913) has done much to explain the physiography of the region.

Briefly, the land is an old peneplain, the rivers of which had an approximately north-south drainage line. Subsequently the region was elevated and a series of step faults cut off the western part, forming a rift valley, now occupied in part by the Gulf St. Vincent. Along the shore of this, near to, and to the north of Adelaide an extensive plain has developed, partly coastal and partly flood in origin. The ancient north-south flow of the rivers has been altered by the elevation of the ground and the streams have been forced to cut new ways to the sea by turning to the west. While the upper reaches of such rivers as the Torrens and Onkaparinga are wide old valleys, in their lower courses they cross the ranges through steep-sided valleys or gorges to empty into the sea through mouths that readily silt up. The rivers themselves are in the nature of intermittent streams that attain the force of torrents during the wet season but almost cease to flow during the summer. The crest of the main Mount Lofty Range lies near to the western face. It consists of a complex of ridges separated by valleys, some of which have steep and rocky sides. These valleys form an intersecting series and run in varied directions. The ridges between may be broad and flat-topped or rather narrow, but for the most part the general outlines are smooth and somewhat rounded, not rugged.

Thirty miles to the south of Adelaide, is an extensive area of rolling hills and wide swampy valleys, the Mount Compass area. It lies rather beyond the area more especially considered by us, but the physiographic conditions are such that it is of great interest. Certain plant communities, but fragmentarily represented nearer Adelaide, are there developed on a large scale in the numerous swamps. The area is a district in which the older rocks are overlaid by more or less unconsolidated deposits due to glacial action in Permo-carboniferous times.

III. GEOLOGICAL AND EDAPHIC.

Geologically the Mount Lofty Ranges consist of a complex series of Cambrian and Pre-Cambrian rocks, often highly metamorphosed by subsequent earth movements. The relationships of the various beds is discussed by Howchin in the papers already cited (also 1904, 1906). As yet no detailed geological map of the area has been published. Even a superficial observation of the vegetation

is sufficient to show that many interesting correlations of the plant communities could be made were more geological data available. To an ecologist the geological work that has been published is most helpful because of the light that it has thrown on the physiography of the region and on the soils.

Soil surveys of the area are not available except for one district, that of Kuitpo forest. This, however, is typical of much of the main range that is occupied by stringybark forests of one type or another. The following data are taken from a bulletin written by Teale (1918). Eight soil types are recognised by him:—

I. Soils derived from quartz schists, quartz mica, and chloritic schists, felspathic schists of Pre-Cambrian age—

A. Yellowish, gravelly, clay loam found on table-top areas. This bears stunted scrub, chiefly *Eucalyptus cosmophylla.*

B. Gravelly loam, principally grey in colour, often stony on slopes. The stringybark timber is poor except in gullies.

II. Soils derived from sandy slates, phyllites, and quartzites of Cambrian age—

C. Gravelly sandy loam, chiefly grey in colour. Has good stringybark.

D. Red, gravelly, clay loam derived from slates and phyllites. Has good stringybark.

III. Tertiary to recent sands, gravels, clays, grits, boulder deposits, and alluviums—

E. Loose deep sands on which grow stringybark, manna gum, and *Casuarina.*

F. Light yellowish-red, sandy, clay loam. Vegetation similar to E.

G. Shallow, light-coloured, fine-textured, sandy clay on very tight clay. Stunted blue gum and pink gum in wet badly-drained areas.

H. Grey to dark-grey sandy loam, clay loam, and silt loam (alluvium), chiefly on valley floors. Typical red gum soil with occasional blue gums.

Our observations are in close agreement with those of Teale on the distribution of the native timber trees. Kuitpo Forest lies within the 30-inch isohyet. With less rainfall we find that blue gum forests develop on gravelly clay loams derived from slates and phyllites of Cambrian age (Teale's soil-type D). The differences in distribution of the trees on similar soil types but with different rainfalls bear out our main contention developed below. It is that the master factor in distribution of the forest types is climatic, but that as the junctions of different climates are necessarily broad in this region, edaphic factors may play an important part in determining the development of one or other forest type along the line of junction.

Teale notes that in all soil types, except the alluvial areas, ironstone deposits may develop. These may vary from loose concretionary gravels, through various degrees of ferrugenous change in slates or quartzites to the local development of aluminous and argillaceous limonite as a hard pan near the surface. These changes are the result of a superficial reaction developing under the climatic conditions obtaining here, specially the alternation of pronounced wet and dry seasons. They are comparable to the development of travertine limestone in calcareous areas. As will be seen below, we have found that these ironstone deposits affect to very considerable degree the constitution of the flora within the forest area.

IV. CLIMATIC.

Situated in lat 34° 56′ S., Adelaide lies about the centre of the area under consideration. The full climatic data for Adelaide extend over a period from 1860 to the present day (Hunt, 1918); the rainfall records are an even longer series, begun in 1839. The full data are given in "Results of Rainfall Observations made in South Australia," 1918, and are summarized annually in "The Commonwealth Year Book." These are the only complete meteorological data for any station in the district, but long series of rainfall records are available for many of the townships included in it. For the purposes of this paper three rainfall stations have been selected as typical of the areas in which the three main forest types recognised by us are developed. They are as follows:—Stirling West, situated near Mount Lofty, at an altitude of 1,628 feet. This is in an area in which the stringybark forest attains its best development. Morphett Vale, altitude 230 feet, lies in a region of low rolling hills about 14 miles south of Adelaide and 4 miles from the sea. The district is now largely developed for agriculture, especially the growth of vines, but it retains many traces of the one-time continuous open woodland composed largely of peppermint, *Eucalyptus odorata*. The third station selected is Mount Pleasant, about 1,200 feet high, situated in the northern portion of the area described. The township is some 26 miles east-north-east of Adelaide, in the wide valley of the upper reaches of the Torrens River. This is an area of open forest composed largely of blue gum, *Eucalyptus leucoxylon*. The general climatological conditions will be shortly discussed for Adelaide, but the rainfall records of the three stations named will be given in some detail.

1. General Features of the Adelaide Climate.

The climate of Adelaide may be said to be warm temperate, an important factor influencing it being the season of maximum rainfall. Over 80 per cent. of the total annual precipitation (which averages 20·953 inches per annum over a period of 78 years) falls during the months April to October inclusive. This results in two well-defined seasons, one comparatively hot and dry, the other cool and wet. The relation between this seasonal rainfall and evaporation is well shown by fig. 2. The total annual evaporation at Adelaide is 54·419 inches

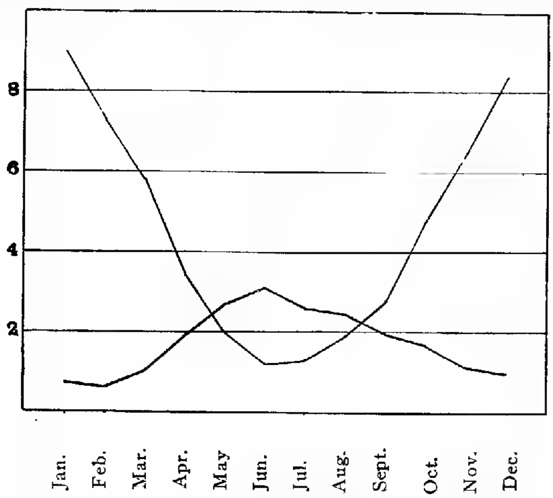


Fig. 2.
Curve showing the mean monthly evaporation and rainfall at Adelaide in inches.

(mean of 47 years), the extremes being 60·953 inches and 46·653 inches. The greatest amount recorded for any one month is for January, 1906, when, with a rainfall of *nil*, the evaporation reached 11·232 inches. The greatest daily evaporation on record is ·560 inches, occurring in December, 1880. A daily evaporation of *nil* may occur between March and October inclusive, and is of common occurrence June to August. Evaporation and atmospheric humidity have such an important effect on transpiration that the following table is of interest:—

Table I.

Mean humidity per cent. at 9 a.m. and 3 p.m., together with mean monthly humidity derived from max. and min. wet bulb readings divided by 2; means over a period of 49 years:—

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean at 9 a.m.	38	41	47	57	68	77	76	69	61	51	43	39
Mean at 3 p.m.	30	31	37	46	57	66	64	57	52	43	37	32
Mean monthly	43	43	49	57	66	73	72	68	64	55	49	45

The mean maximum humidity on record is 94 per cent. for a 9 a.m. reading in June, 1857, and the mean minimum is 21 per cent. for a 3 p.m. reading in January, 1915.

Temperature records are available for a period of 60 years and show considerable range. The absolute highest and lowest shade temperatures are 116·3° F. and 32·0° F., respectively. The mean figures for 60 years show that 43·6 days have a temperature of 90° F. and over, 13·5 days per annum exceed 100° F. On the other hand, only on 14·3 nights is the temperature below 40° F. The mean maximum and minimum shade temperatures are as follows:—

Table II.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean max. °F.	86·5	86·2	80·8	73·2	65·4	60·2	58·7	62·0	66·2	72·5	78·6	83·4
Mean min. °F.	61·6	62·1	58·9	54·6	50·0	46·6	44·5	45·9	47·8	51·4	55·3	58·9

In considering the effect of temperature on vegetation the figures for solar and terrestrial radiation are of even more importance than the shade temperatures. These are available for periods of 39 and 56 years, respectively, and are given in Table III.

Table III.

Mean solar and terrestrial radiation (grass). Degrees Fahrenheit:—

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Solar radiat. ...	145·6	144·9	138·7	129·3	118·3	110·7	111·2	117·6	125·5	132·3	138·5	142·8
Terrest. radiat.	54·4	54·5	51·6	47·5	43·4	40·4	38·0	39·5	41·6	45·2	49·0	52·2

The highest temperature on record for solar radiation is 180·0° F. and the lowest for the grass reading is 22·9° F.

These figures, coupled with those for the total number of hours of sunshine (2531·5 on an average of 35 years), show that the insolation factor may be important in determining growth forms of the plants. The harmful effect of minimum temperatures, on the other hand, is rarely felt. Ground frosts may occur between April to October, but are rare in these two months, there being only four cases of frost recorded in April over 45 years and two in October during the same period. The mean maximum for frost occurs on July with 3·3 days. The mean for the whole year during the 45-year period is 7·8 days. Naturally the frost effect is less on the Adelaide plain than in the hills, where, in some of the valleys particularly, the occurrence of winter frosts is common. The forester at Kuitpo attributes the remarkably sharp line that divides the stringybark forest from that of red gum at the edges of certain flat-bottomed valleys to frost influence (Teale, p. 12). He states that stringybark seedlings are very susceptible to frost injury. This may be one of the contributory causes differentiating at their junction what we regard as two distinct forest types.

2. Rainfall Data for Selected Stations.

Rainfall records are given in Table IV. for the three selected stations.

Table IV.

Mean annual rainfall in inches.

Locality	No. of years	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Stirling West	32	1·49	0·95	1·96	4·13	4·83	8·10	6·04	6·15	4·73	3·66	2·10	1·77	45·91
Morphett Vale	29	0·82	0·58	1·22	2·19	2·56	3·40	2·79	2·71	2·28	1·85	1·32	0·95	22·67
Mount Pleasant ...	40	0·81	0·69	1·23	2·27	2·81	4·31	3·47	3·41	3·05	2·23	1·82	0·96	26·56

In the following three graphs, in addition to the mean annual rainfall, the annual rainfalls for the wettest and driest years on record are given, also the highest and lowest falls on record for any month.

It will be seen that the distribution of the rainfall at all three places is of essentially the same type, *i.e.*, a winter rainfall. The difference in amount between the totals at Stirling West and those of the other two stations is considerable (fig. 6). This difference is due to altitude and proximity to the open sea, which, as Griffith Taylor points out (*l.c.*, p. 99), is well shown in the distribution of rainfall in South Australia as a whole. The district under consideration is amongst the most reliable in Australia so far as annual deviation from the normal rainfall is concerned, but the graphs show that over the periods during which records have been kept considerable deviations from the monthly averages have been recorded. In particular the hot months—December, January, and February—may be almost or quite without rain. It will be seen, however, that in the drought-year curve the deficiency of rain was due to a failure of the winter rains from May onwards rather than to exceptionally dry summer weather.

In considering the climate of these ranges the persistence of cloud at the higher altitudes must be taken into account. This is very marked near Mount Lofty Summit, and an appreciable amount of water which will not affect the annual rainfall must condense upon the vegetation. Precipitation at Mount Lofty is occasionally in the form of snow. The snow rarely lies many hours, and falls, though recorded on several occasions during the past 83 years, are by no means annual occurrences.

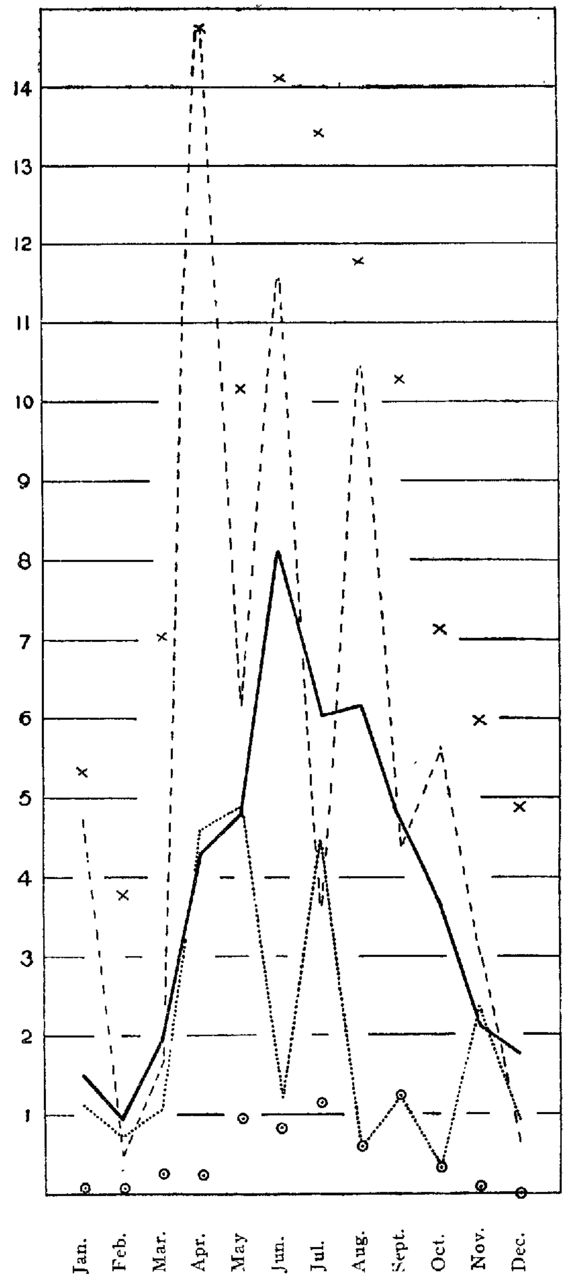


Fig. 3.
Graph of precipitation at Stirling West showing mean annual rainfall on records for 32 years, the curve for the wettest year (1889), the driest year (1914), also the maximum and minimum rainfall for any month during the total period.

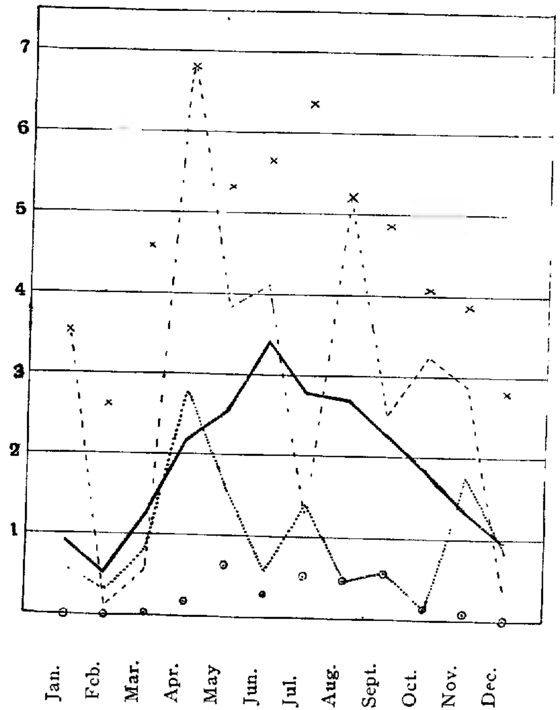


Fig. 4.
Graph of precipitation at Morphett Vale showing mean annual rainfall on records for 29 years, the curve for the wettest year (1889), the driest year (1914), also the maximum and minimum rainfall for any month during the period.

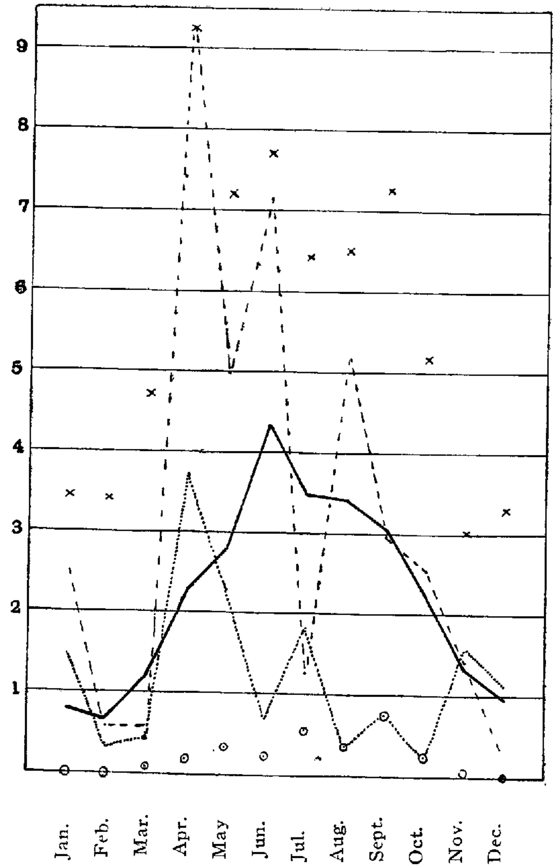


Fig. 5.
Graph of precipitation at Mount Pleasant showing mean annual rainfall on records for 40 years, the curve for the wettest year (1889), the driest year (1914), also the maximum and minimum rainfall for any month during the period.

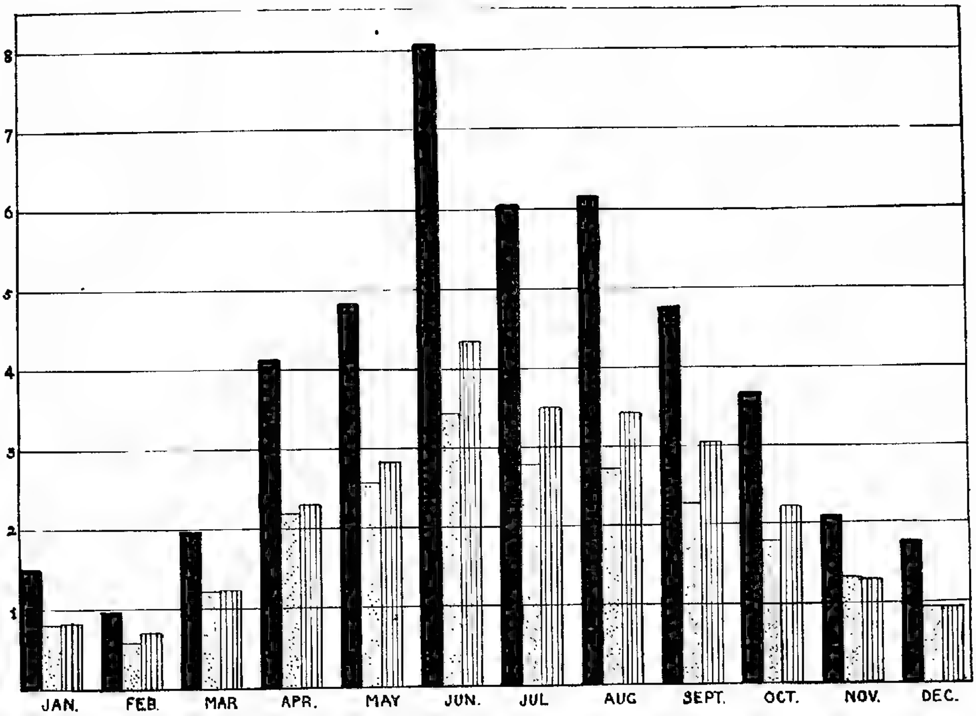


Fig. 6.
Graph comparing the mean annual rainfalls at Stirling West (black) Morphett Vale (stipple), and Mount Pleasant (ruled).

V. PREVIOUS WORK.

Very little has been published previously on the ecology of this region, though much floristic work has been done. A short paper by one of us (Osborn, 1914) may be cited as distinguishing between the savannah type of forest on the plains and hills of nonsilicious rocks and the stringybark forests or scrub on soils formed from quartzitic rocks. A second short paper (1918) describes in some detail a rather specialized type of plant community, the seasonal swamp, interesting as the habitat of *Phylloglossum Drummondii* and *Isoetes Drummondii*. In the bulletin on the "Soil Survey and Forest Physiography of Kuitpo" already cited (Teale), the principal forest trees are connected with the soil types on which they grow within that area.

VI. VEGETATION.

In the following pages the vegetation is described under the chief communities that we have recognised in the field. Additional notes on climatic or physiographic features are given in connection with the vegetation types that are influenced by them.

1. Stringybark (Eucalyptus obliqua) Forest.

Forests of stringybark cover the main ridges of these hills, whose core is composed of quartzites or other rocks that are rich in silica. The soil derived from these rocks varies somewhat (see ante, p. 90). The harder quartzites produce a shallow, coarse, sandy soil; other beds give a finer-grained soil, but always with a high percentage of sand. Locally, deep sandy soils are formed.

These silicious soils have all the appearance and characters of relatively "acid" soils which are poor in soluble gases, though no large series of determination of the reaction have been made. Preliminary tests of the pH support this view. These sandy and ironstone soils occur as the backbone of the range and occupy nearly all the country receiving an annual rainfall of 30 inches or more.

The whole area is naturally a forest region; except when clearing has been carried out, almost the only break in the forest cover occurs in flat-bottomed swampy valleys. While the forests vary somewhat in character, the major part is composed of *Eucalyptus obliqua,* here known as stringybark, though in the Eastern States this tree is termed "Messmate." This tree occurs pure over great areas, but may be associated with other species of the genus *Eucalyptus.*

The Chief Tree Species.

E. obliqua may attain a considerable size, though in the forests on these ranges trees over 80-90 feet are rare. The trees do not form a close canopy (pl. x., fig. 1), and especially when mature stand at considerable distances from one another. This species, like the majority of the genus, has pendant leaves, which thus do not cast a dense shadow. All through the forests regeneration takes place readily from seed, especially after cutting or firing, also from coppice shoots. In nearly all the forests young trees of all ages can be found, especially in the spaces between the large trees. *E. obliqua,* like so many other species of *Eucalyptus,* is a marked light-demander and intolerant of shade at all stages of its life. This is very obvious in forests composed of old trees: here regeneration is quite absent within the sphere of shading of the old trees, while in gaps between a thick growth of young trees occurs.

E. obliqua, as mentioned, may be associated with or even locally replaced by other species. Among these is another stringybark, *E. capitellata,* which occurs especially on the poorer and shallower soils. This is a tree very similar in general appearance and growth to *E. obliqua,* and in the absence of fruit is not very easily differentiated in the field. *E. capitellata* has, in general, a darker and more furrowed bark, and in the crown a less even distribution of foliage, the leaves being bunched towards the extremities of the branches.

Local bushmen in many cases do not seem to differentiate clearly between these two trees. They do distinguish two kinds of stringybark, using two different criteria: the colour of the timber, either yellow or white; and secondly, the thickness of the bark. Trees with a very thick bark are called "Woollybutts." But timber of both colours may occur in either species, and we have had trees pointed out to us as stringybark and woollybutts, respectively, which botanically were undoubtedly the same species. In both species age, and also the nature of the soil and habitat generally seem to have a decided influence on these features.

Another species of stringybark, *E. muelleriana,* which is very closely allied to *E. capitellata,* is recorded from Mount Lofty (Maiden, p. 220), but seems scarcely distinguishable here.

Besides these, *E. fasciculosa,* pink gum, and *E. cosmophylla,* scrub gum, occur in the forests. Other trees are not common, *E. viminalis,* manna gum, is confined to deep gullies, where also some other plants may attain tree size, as is described later; *Casuarina stricta* occurs on rocky slopes, but not in the forest proper.

The Life-forms and Leaf-types.

The undergrowth in these forests varies considerably in its composition in different parts, but all through it has one general facies, consisting, as it does, of a more or less dense growth of xerophytic undershrubs. These stand on the

average about 2-3 feet in height, though much taller growths occur. This undergrowth has a dark, often brownish, colouration that is in many ways reminiscent of a European heath growth. Before the details of the distribution of the undergrowth are considered, a word or two may be said about the general life-forms and leaf-types.

While the leaf of the dominant tree is somewhat of the sclerophyll type, the undergrowth as a whole is characterised by the possession of small leaves which are often ericoid or cylindrical. Such leaves are shown by the Epacrids *Astroloma Sonderi, Epacris impressa, Leucopogon virgatum,* also by *Tetratheca ericifolia, Daviesia ulicina, Dillwynia hispida, Gompholobium minus,* and by the *Proteaceae, Persoonia juniperina, Grevillea lavandulacea, Hakea ulicina, H. rostrata; Isopogon ceratophyllus,* with its very hard divided leaves, may also be classed here. Other common plants with this general leaf-form are *Hibbertia acicularis, H. sericea,* and *Calythrix tetragona.* Pungent leaf-points are a common feature.

Larger and broader leaves of a sclerophyll type are possessed by *Banksia maginata, Pulienaea daphnoides, Daviesia corymbosa,* and by the phyllodes of *Acacia myrtifolia. Dodonaea viscosa* has broad and rather thin leaves which, however, have a lacquer-like varnish on the surface (Collins), a feature also possessed by *Ixodia achillaeoides, Spyridium vexilliferum,* and others.

Aphyllus plants, or plants with very reduced leaves and an assimilating stem, are not very prominent; besides two species of *Casuarina,* there are *Daviesia brevifolia, Acacia spinescens,* the parasitic *Exocarpus cupressiformis,* and a few others.

Xerophytic monocotyledons are relatively abundant; the long, hard, glaucous leaves of *Xanthorrhoea semiplana* and more locally of *X. quadrangulata* are quite a feature of the undergrowth. Other common xerophytic monocotyledons are species of *Lomandra (Xerotes)* and of *Lepidosperma.*

Hairy leaves are by no means common, so that *Hibbertia sericea* appears quite exceptional. A few plants such as *Banksia maginata* have appressed hairs on the under surface of the leaf, but the vast majority of the shrubs are almost or quite glabrous. Leaves covered with hairs, however, are found among the smaller plants which come up in the early summer, as, for example, *Helichrysum apiculatum, Dampiera rosmarinifolia,* and *Brunonia australis.*

A number of geophytes occur in the forests, though no individual species is abundant. These plants are much less markedly xerophytic; most of them, however, have few leaves or even only a single one. The leaves are either narrow, as in *Bulbine bulbosa, Burchardia umbellata, Cassia vittata,* and *Dichopogon strictus,* or, when broader, are closely pressed to the surface of the soil. Such surface leaves are a feature of several orchids, *Acianthus, Corysanthes, Lyperanthus,* species of *Pterostylis,* and others. All the geophytes have a short vegetative and flowering season; they appear in the spring after the winter rains, but in most cases by midsummer very little trace of them can be seen above ground.

Grasses occur, but as scattered individuals, and nowhere give character to the undergrowth; the most abundant are *Stipa* spp., *Dichelachne* spp., and *Danthonia penicillata.*

Climbing plants are strikingly rare in these forests, and none of any size are present. The most abundant is the parasitic *Cassytha.* Other climbers are the beautiful *Marianthus bignoniaceous* and *Hardenbergia monophylla,* with rather broad shining leaves, the former being confined to sheltered moist gullies. *Billardiera cymosa* occurs, but scrambles rather than climbs. Of the few herbaceous climbers *Glycine clandestina,* a vetch-like plant, and *Thysanotus Patersonii,* are the most common.

Epiphytes are quite absent. Even bryophytes and lichens do not flourish here on the trees. In this connection it may be noted that lichens do become common on dead limbs of trees when the bark has fallen off. They are also abundant on the living barks of many introduced orchard or ornamental trees. Their absence on living trees of the forest, then, may have some relation to the deciduous bark of the "gums" or the thick fibrous bark of the stringybarks. The liverwort *Cheiloscyphus exilifolius* is a common feature of charred trunks of stringybarks.

These forests possess a considerable number of parasitic plants. Besides *Exocarpus*, of which mention has already been made, there are quantities of *Cassytha*, both the larger *C. melantha* and the smaller *C. glabella*. Both grow on a considerable range of host plants, and both commonly twine round shoots even when no haustoria are formed. *C. glabella* especially is a very characteristic feature of the undergrowth. *Loranthus* occurs, but stringybarks are much less attacked by *L. Miquelii* than are many gum trees. It is often quite striking how abundant this parasite becomes when one passes from a forest of *E. obliqua* to one of, say, *E. leucoxylon*. While in the former the trees are almost free from *Loranthus*, in the latter they are often covered by it, hardly a tree in a forest being free. *L. Exocarpi* occurs on *Exocarpus*, species of *Acacia*, and other shrubs. Besides these the semiparasitic *Euphrasia Brownii* is locally abundant.

Saprophytes are represented by the peculiar chlorophyll-less orchid *Dipodium punctatum*, which is, however, not at all common.

While noticing these parasitic plants, it may be remarked in passing that a very large number of plants, trees, shrubs, and herbs are commonly deformed by galls caused by either insects or fungi, notably *Uromycladium Tepperianum* on *Acacia* spp.

Communities of the Forest.

The actual composition of the flora in the stringybark forest varies considerably in different parts; the variations depend on changes in soil, topography, and of climate. For purposes of description four main types can be recognised, namely, forests on quartzite soils, on ironstones, stunted forests on glacial deposits, and forests in sheltered gullies.

Forests on Quartzite Soils.

These are the most extensive, and as such may be treated as typical. A very characteristic community here is present on the plateaux of the larger quartzite ridges where the rainfall is 25 inches or over. On Mount Lofty itself rainfall as much as 44 inches is recorded. The soil under these conditions is sandy but shallow, being not over 12 inches in depth, and often much less. Stones are frequent. No distinct humus layer is present, though the surface soil is somewhat dark coloured. Here the canopy is usually composed of pure *E. obliqua*, though *E. capitellata* may occur locally mingled with it. The undergrowth consists of a varied assemblage of shrubs and smaller plants which rarely form really continuous layers (pl. x., fig. 2). Among the most abundant and characteristic are *Acacia myrtifolia* and *Pultenaea daphnoides*. Other prominent plants are *Hakea rostrata, Epacris impressa, Astroloma Sonderi, Leucopogon virgatum, Daviesia corymbosa, Platylobium obtusangulum, Tetratheca ericifolia, Xanthorrhoea semiplana, Lepidosperma semiteres*, while less abundant are *Astroloma humifusa, Hibbertia acicularis, Grevillea lavandulacea, Persoonia juniperina*, and *Isopogon ceratophyllus*. Among the more prominent of the smaller or seasonal plants may be mentioned *Drosera Menziesii, Cassytha glabella, Lomandra (Xerotes) dura, Goodenia geniculata, Brunonia, Wahlenbergia gracilis, Craspedia Richei*, and a great many others.

When the trees are large this undergrowth is irregular in its distribution; in the shade a very open and scattered assemblage is present, while a dense growth with numerous young trees occurs in the open spots.

These forests are very liable to damage from bush fires; the long, warm, dry summer and the prevalence of volatile oils in the plants are both contributory factors. Indeed, there are few if any existing forests on these ranges which have not at some time or another been burnt. The severity of the damage varies greatly; in some cases the undergrowth alone is burnt, while at other times the trees are also affected. The stringybark, however, is a tree exceedingly resistant to fire damage; even when the fire reaches right up to the crown it is, as a rule, not killed, but sprouts out afterwards from numerous dormant buds on the stem and branches (pl. xi., fig. 1). Many of the extremely irregular shapes assumed by these trees can be related to this periodic destruction of the smaller branches by fire and subsequent sprouting of dormant buds. It requires a very severe fire indeed to kill mature stringybark trees.

After a fire a vigorous crop of seedling trees appears. The capsules are very resistant and not destroyed, though the heat causes them to open and to shed the seeds.

After a fire it is not infrequent to find tree seedlings appearing as the most conspicuous part of the undergrowth. Regeneration of the undershrubs takes place, however, rather quickly. After a light ground fire it may be direct owing to shoots from adventitious buds which are developed after a fire or mechanical injury upon the roots of many species. A more severe burn causes considerable changes before the typical condition is again established. Certain plants seem to be stimulated to increased growth and reproduction by a forest fire. A noticeable example of this is *Xanthorrhoea semiplana*. This plant rarely produces flower and fruit unless a fire occurs (pl. xi., fig. 2). In the season following a fire it produces a remarkable picture, a forest of stiff erect spikes of its white flowers appearing. After a rather long interval the composite *Ixodia achilleoides* appears in great abundance, and for two, three, or even more seasons takes a very prominent place in the undergrowth (pl. xii., fig. 1). Owing to the abundance of this plant, with its relatively wide lacquered leaves, the undergrowth has a fresher, greener appearance shortly after a fire than at other times. After about three years *Ixodia* comes to be associated with other plants whose seeding is favoured by fire, namely, *Hakea rostrata, H. ulicina,* and *Leptospermum myrsinoides,* whose slower growing seedlings have not been apparent in the earlier stages. The latter especially becomes very abundant and gradually ousts the *Ixodia.* The presence in these forests of large quantities of *Xanthorrhoea semiplana* and *Leptospermum myrsinoides,* with or without *Ixodia achilleoides* may almost be taken as an indicator of a previous bush fire. The other plants gradually reassert themselves; *Acacia myrtifolia* is much more rapid in regeneration than *Pultenaea daphnoides* and many others.

Effect of Local Changes in the Environment.

Changes in the flora occur in drier situations. On the lower hills, with a less rainfall, and on open slopes, where the soil has little power of retaining moisture, *Pultenaea daphnoides* and *Acacia myrtifolia* are very much less abundant or are even quite absent. The former may be replaced to some extent by the small-leaved *P. graveolens.* On the other hand, *Astroloma Sonderi* and *Tetratheca ericifolia* occur in greater quantity, while *Hibbertia sericea* and *Olearia tubuliflora* are often abundant. At lower altitudes *Acacia pycnantha* may be present in some quantity.

Some variation in the flora occurs on the slopes in accordance with the exposure, whether they receive the full glare of the sun or not. Those slopes

that face the south have a flora closely approximating to that on the higher plateaux. In some cases, where the angle of the slope is high and little direct midday sun reaches the ground, the flora includes species which are characteristic of sheltered and relatively moist conditions. Among such are *Acrotriche fasciculiflora*, which may locally approach dominance, *Senecio hypoleucus, Logania linifolia, Olearia grandiflora*, and sometimes *Acacia melanoxylon.* The ferns also, *Cheilanthes tenuifolia* and, locally, *Pteridium aquilinum* may be present in some quantity. In contrast to this flora, on slopes with a northern exposure very much more xerophytic conditions are apparent. *Acacia myrtifolia* and *Pultenaea* are quite absent, while such plants as *Hibbertia sericea, Olearia tubuliflora*, and, locally, *Xanthorrhoea quadrangulata* are abundant. The pink gum, *Eucalyptus fasciculosa*, is present in greater amount on these sunny slopes and may locally replace the stringybark (pl. xii., fig. 2).

When the slope becomes very steep and rocky, and so is liable to frequent and continued drought, stringybark may be absent, or at most only descend a short distance from the plateau. Its place is taken by a rather stunted forest of *E. fasciculosa*, which has a xerophytic undergrowth in which *Hibbertia sericea, Olearia tubuliflora, Hakea rostrata*, and *Tetratheca ericifolia* are the chief species, along with *Astroloma Sonderi, Hybanthus floribundus*, and *Pimelea glauca.* Such plants as *Acacia myrtifolia, Pultenaea daphnoides, Epacris impressa*, and others are here confined to gullies and watercourses. This scrub forest of pink gum is developed on the sunny northern slopes of ridges, and a sharp contrast is obtained on comparison with the southern slope, which, though equally steep, has a forest of *E. obliqua*, with an undergrowth of Epacrids, *Platylobium* and such plants.

Where the slope becomes so steep that it assumes the aspect of a cliff, and little or no surface soil is present, *Eucalyptus* forest is absent; its place is taken by an open community in which *Casuarina stricta* and *Xanthorrhoea quadrangulata* are the most prominent plants. The former assumes the stature of a low tree, while *Xanthorrhoea* varies in height from 2 feet to as much as 10 to 12 feet without considering the crown of leaves or the inflorescence. Associated with these two is a more or less open assemblage of plants which creep on the ground or are of dwarf stature, *Astroloma humifusa, Hibbertia sericea, Olearia tubuliflora, Pimelea glauca*, and *Astroloma Sonderi.* Amongst these are scattered a number of herbaceous plants which are more prominent here than in the general forest; the most abundant are *Goodenia geniculata, G. pinnatifida, Scaevola microcarpa, Brunonia australis, Halorrhagis tetragyna*, and, locally, *Themeda triandra* (=*Anthistiria ciliata*). Besides these *Lomandra (Xerotes) dura* and *L. micrantha*, and occasionally *Cheilanthes tenuifolia* are frequent. At the foot of cliffs or at the bottoms of valleys bushes of larger size may occur here, especially *Dodonaea viscosa, Anthocercis angustifolia*, and locally, *Acacia rupicola.*

The relative proportion of *Casuarina stricta* varies with the aspect and with the local conditions. It is most abundant where solid rock outcrops, and less so on broken rock. On cliffs with a southern exposure especially it becomes luxuriant, and may form closed communities, a condition that also occurs on the steep sides of narrow gorges. *Casuarina stricta* also replaces the Eucalypts where rock comes to the surface, not only on such slopes as described, but also on the edges of ridges and by waterfalls.

Forests on Ironstone Soils.

(a) Coarse Ironstone Soils.—As was mentioned earlier, ironstones are of two kinds, namely, a quartzitic soil impregnated and partially cemented by iron

and a solid, rather fine-grained ironstone rock. These two kinds of ironstone bear vegetation that is very different and will be described separately.

The vegetation on the quartzitic ironstone gravels is not very different from that on the ordinary quartzites. *E. capitellata* is generally present associated with the dominant *E. obliqua*. The undergrowth is sparser and more open, *Acacia myrtifolia* and *Epacris impressa* are much less abundant. Such plants as *Hakea ulicina, Daviesia ulicina,* and *Pimelea glauca* are abundant. Small plants as *Kennedya prostrata, Halorrhagis tetragyna, H. ceratophylla,* and *Helichrysum scorpoides* are more prominent. Locally the orchids *Thelymitra grandiflora* and *Pterostylis vittata* are frequent.

While these forests that occur on this kind of ironstone are very closely allied to those on quartzite soils, a distinct type is developed in situations where the rock itself is impregnated with iron. Here generally the soil is very shallow though sandy. The trees are here smaller and stand further apart from one another. *E. capitellata* is, as a rule, the most abundant, and, while it may occur in association with *E. obliqua,* frequently stands alone. *E. fasciculosa* occurs as an undertree, and occasionally plants of *E. cosmophylla* may be present. In the undergrowth the most prominent plant is undoubtedly *Casuarina distyla*. This plant is exceedingly variable both in its size and general form. It occurs in all sizes from a small undershrub of 1 to 2 feet up to trees of 10 to 15 feet, and varies almost as much in its general shape. Most commonly it forms a spreading bush with no distinct main axis; at other times it is erect with rather fastigiate branching. The tree forms have ascending branches. How far some of these forms are distinct races or varieties is a matter that certainly calls for study and attention.

Along with this *Casuarina* the most abundant plants are *Xanthorrhoea semiplana, Calythrix tetragona, Astroloma Sonderi, Daviesia brevifolia, Isopogon ceratophyllus,* and *Hybanthus floribundus,* with lesser quantities of *Pimelea glauca, Spyridium vexilliferum, Dillwynia hispida, Hakea rostrata, Pultenaea villifera,* and others. In such situations *Lomandra (Xerotes) filiformis* frequently occurs in large grass-like tufts. The resemblance to a grass is heightened owing to the fact that *Danthonia penicillata* frequently finds a nidus in the centre of such a patch, and its inflorescences appear above the surrounding leaves of the lilaceous plant. *Neurachne alopecuroides* occurs not infrequently on these ironstones. The general aspect of the undergrowth is more xerophytic than on the quartzite soils; a greater proportion of the plants have small leaves with pungent points.

Where these rocks occur on steep sun-baked slopes the forest is replaced by a scrub with only scattered, stunted, bush-like trees of *E. fasciculosa*. The bulk of the vegetation is composed of *Casuarina distyla, Xanthorrhoea quadrangulata,* with *Astroloma Sonderi* and *Calythrix tetragona*. Other abundant plants are *Hybanthus floribundus, Daviesia ulicina, Leucopogon virgatum, Xanthorrhoea semiplana, Lepidosperma viscosum,* and many others.

This assemblage, along with a large number of subsidiary species, forms a highly xerophytic scrub that bears much resemblance to the maquis of the Mediterranean coasts. As forests of *E. capitellata* and *E. fasciculosa* occur wherever a plateau is reached and in gullies, it would seem that this scrub is a community prevented from its full development owing to the physiographic factors.

These ironstone communities are as frequently devastated by fire as are those of the quartzite. Regeneration here is, however, generally more direct; *Casuarina distyla* sprouts very readily from the stool, and *Xanthorrhoea* is constantly encouraged in reproduction by fire. While *Ixodia achilleoides* and *Leptospermum myrsinoides* do appear after fire, they never become so

important in the vegetation as is the case in the forests described earlier. The very rapid regeneration and spread of the *Casuarina* after fire may to a large extent inhibit the establishment of seedlings of *Eucalyptus*, and some of the areas of *Casuarina-Xanthorrhoea* scrub on this type of soil which have scattered trees may well be the result of fire and the subsequent prevention of tree regeneration by the rapid strong growth of these plants.

(b) Fine Ironstone Soils, Eucalyptus cosmophylla Scrub.—When one passes to a region of the hard, fine-grained, ironstone rock a change in the vegetation is at once apparent. Forest ceases often quite abruptly, and its place is taken by a dense scrub that rises only 4-10 feet. The characteristic and dominant plant here is the scrub gum *E. cosmophylla*. The transition to this scrub may be quite a sharp line, or in some cases there is a transition zone where dwarfed trees of *E. capitellata* and *E. obliqua* occur with the scrub gum. Where growing luxuriantly *E. cosmophylla* forms very dense thickets in which other plants are suppressed except in spaces between the dwarf trees. The most general associated species are *Xanthorrhoea semiplana, Casuarina distyla, Daviesia brevifolia, Isopogon ceratophyllus, Hakea rostrata, H. ulicina, Leucopogon virgatum, Astroloma humifusa*, and *Leptospermum myrsinoides*, with many others in less quantity. After fires the *Xanthorrhoea* increases considerably and for a long period may hold its place in competition with the gum which regenerates readily but slowly.

These scrub communities of *E. cosmophylla* occur for the most part on the relatively level ground on the tops of ridges, but can also maintain themselves on steep slopes. On some of the lower flat-topped ridges and watersheds the solid ironstone may be some distance below the surface and be overlaid by 2-3 feet of a soil of a loamy consistency which is very retentive of water in winter but becomes baked very hard and dry in the summer. In this type of locality the shrubby trees are much more stunted, frequently not attaining a greater height than 3 feet. Besides their small size they are more scattered and attain a much less degree of dominance; *Xanthorrhoea semiplana* is here very abundant and takes an almost equal part with the eucalypt in controlling the community. On this soil some small moisture-loving species are exceedingly abundant in the Spring, notably *Drosera Whittakeri, Schoenus apogon*, and *Chamaescilla corymbosa*.

Scrub communities of *E. cosmophylla* are not solely confined to these hard ironstones, but also occur on portions of ridges where the rock is a hard crystalline quartzite which weathers slowly to a shallow, rather compact soil. In this case the flora is more like that of the stringybark forest; *Casuarina distyla* is not abundant, while *E. fasciculosa* and *E. capitellata* in a stunted form are frequent, though they scarcely compete for dominance with the scrub gum. The most general associated plants are: *Xanthorrhoea semiplana, Astroloma Sonderi, Leucopogon virgatum, Acrotriche serrulata, Leptospermum myrsinoides, Hibbertia sericea, Hakea rostrata, H. ulicina, Daviesia ulicina*, with more locally some quantity of *Lissanthe strigosa, Acacia myrtifolia, Calythrix tetragona, Tetratheca ericifolia*, and *Isopogon ceratophyllus*.

These communities are in most respects intermediate in their characteristics between the stringybark forest and the typical scrub-gum community. This intermediate feature is correlated with their habitat, which agrees with the ironstone one in having a very hard resistant rock and a relatively fine-grained soil, while it approaches the quartzite habitat in the siliceous and rather sandy nature of the soil.

All these scrub communities of *E. cosmophylla* are very closely allied to the *E. obliqua* forest and seem to represent variations due to local changes in habitat. The great difference in the growth habits of the two dominants gives an impression of much more wide divergence than a closer study shows to actually

exist. A study of the associated species and undergrowth shows that all the plants occurring in the scrub communities also occur in the forest. The relative frequencies are different, and many of the forest plants are absent from the scrub, but our studies have not revealed a single species peculiar to the latter. As might be expected from their habitat, the scrub communities are more markedly xerophytic than the general forest. The broader-leaved and shelter-loving species are either absent or present in very much reduced quantities. Thus *Pultenaea daphnoides, Epacris impressa, Daviesia corymbosa,* and *Platylobium obtusangulum* are rare, while *Olearia grandiflora, Exocarpus cupressiformis,* and *Acacia myrtifolia* are absent. Even in those communities on the deeper poorly-drained soils this xerophytic facies is apparent; the only moisture indicators are small plants, geophytes or annuals, which flourish in Winter and Spring. *E. cosmophylla* itself has harder and thicker leaves which are wax covered and have the appearance of more marked xerophytic features than those of the forest trees.

Scrub on Glacial Deposits.

As mentioned earlier, in the southern parts of the ranges the solid rock for considerable stretches is overlaid by glacial deposits of Permo-carboniferous age. These are specially well represented on the watershed between Willunga and in the neighbourhood of Mount Compass. Those glacial deposits may be of very considerable thickness. They vary greatly in character; while some are consolidated to rock, most are loose (Howchin, 1910). The soils produced are largely sandy, though ironstones occur not infrequently. The soils are nearly all very retentive of water but liable to great drought in summer.

The vegetation on these soils is very characteristic; trees are quite absent. The ground is clothed by an open scrub not rising more than 4-6 feet, and generally very much less. The composition of the scrub is variable; the plants very often grow in groups or patches. Some of these are determined by local edaphic conditions, while others seem rather to be the result of the habits of growth and reproduction of the plants and of competition.

The plant which perhaps gives most character to the scrub is a dwarf form of *Eucalyptus capitellata,* which here grows commonly as a branching bush 2-6 feet in height, and rarely exceeds 6-8 feet. These small-sized bushes may be of very considerable age and produce flowers and fruit quite freely. The relations of this dwarf form to the tree form and the exact determining conditions for each are subjects well worthy of detailed work. *E. fasciculosa,* also in a dwarfed state, also occurs here, but is much less abundant. While *E. capitellata* gives a general character to the scrub, it cannot be described as dominant. It occurs as local patches and scattered individuals (pl. xiii., fig. 1). Along with it, and often also occurring in patches, the most abundant of the larger plants are: *Casuarina distyla, Hakea ulicina, H. rostrata, Pultenaea villifera, Banksia marginata* (a dwarf form), *B. ornata* (generally more abundant than the first-named species), *Daviesia brevifolia, Isopogon ceratophyllus,* and *Xanthorrhoea semiplana. Acacia myrtifolia* is locally abundant. Amongst and between these plants there occurs a varied assemblage of smaller undershrubs, some of which are very characteristic here, though not occurring in the forests. Perhaps the most abundant of these restricted plants are: *Conospermum patens, Adenanthos terminalis, Boronia caerulescens, Pultenaea villifera, Spyridium parvifolium, Baeckea diffusa.* Also abundant but of wider distribution are: *Grevillea lavandulacea, Platylobium obtusangulum, Dillwynia floribunda, Daviesia ulicina, Correa speciosa, Cryptandra hispida, Calythrix tetragona, Pimelea octophylla, P. glauca, P. phylicoides, Leucopogon concurvum, L. virgatum, Astroloma Sonderi, A. humifusa, Epacris impressa,* while a large number of others occur more occasionally.

Among the numerous herbaceous plants mention may be made of *Helichrysum Baxteri, H. semipapposum, H. Blandowskianum,* and *Euphrasia Brownii,* which are abundant and characteristic. The scrub is an open community with frequent patches of bare soil between the plants and with an exceedingly varied flora. Besides the plants already mentioned, *Cassytha melantha* is here exceedingly abundant, often forming large sprawling patches on the bushes and binding them together. The leafless semi-parasitic *Choretrum glomeratum* occurs here and appears to take the place of *Exocarpus* in the forests. It may be mentioned, as a contrast to the ironstone communities, that *Casuarina distyla* here is always a low shrub, indeed it not infrequently has a semi-decumbent habit, forming large circular patches in which the main branches are horizontal and on the surface of the ground, while the assimilating shoots stand erect.

In some parts of this area the soil is a deep rather loose sand, and in such situations rather a marked change in the flora occurs. The shrubs are almost or quite absent, *Xanthorrhoea* is present, but the flora is essentially herbaceous and of low stature. The chief species are two species of Restionaceae, *Hypolaena fastigiata, Lepidobolus drapetecoleus,* and *Gahnia lanigera,* which form an open community in which are scattered individuals of *Poranthera ericoides, Xanthosia dissecta,* and others. These sandy patches are generally of limited extent, but are quite sharply defined; one passes suddenly from the dwarf *Eucalyptus-Casuarina* scrub to the open community containing Restionaceous plants.

Another change of flora due to local edaphic conditions is seen here in those parts where ironstone is developed. This ironstone is chiefly found as a capping to the low rather rounded hills. Here the characteristic *E. capitellata* is replaced by a dwarf form of *E. cosmophylla,* which here forms a scrub about knee high. It occurs almost pure or mixed with *Casuarina distyla,* which is always very low. On these ironstones the flora is much less varied and poorer in species. Only the most xerophytic seem able to attain a footing; the most abundant are *Xanthorrhoea semiplana, Hibbertia sericea, Hakea rostrata,* and *Leucopogon virgatum.* Such plants as *Correa, Conospermum, Pimela, Epacris,* and others are absent. A few species are more abundant here, the most noteworthy being *Stylidium graminifolium, Persoonia juniperina,* and *Tetratheca ericifolia.* Herbaceous plants are conspicuously less abundant here.

The development of low scrub communities on these ancient glacial drifts seem mainly determined by edaphic conditions. In the Mount Compass region the summits and upper slopes of some of the hills have been cleared of drift by erosion, and the solid rock, here Pre-Cambrian gneiss or quartzitic schist, is laid bare. In such places, unless the exposure to wind and sun is very great and the rock area very small, the scrub is replaced by a tree growth of *E. fasciculosa* or a form of *E. cosmophylla* that attains a height of 20-30 feet. The undergrowth is also quite different and like that of dry, rocky, stringybark forests. At the limits of the drift-covered area there is quite a narrow zone of transition between the forest and the scrub.

A study of the flora and its relations to soil variation leads to the conclusion that there is a close alliance between the scrub on glacial soil and the stringybark forest. Not only is the general facies of the flora very similar, but there is also a very high percentage community of species. Though dwarfed in form there is the same relation to soil conditions between *E. capitellata* and *E. cosmophylla* existing in the scrub, as was described earlier in the forest. Further, it is interesting to note that in the stringybark forest, where, in a few localities, the soil is a deep loose sand, some of the very characteristic plants of the scrub are present. The trees are *E. capitellata,* and in the undergrowth there occur *Pultenaea villifera, Conospermum patens,* with locally an abundance of *Hypolaena fastigiata.* Generally speaking, one might say that there is the same flora, but

in one case with trees, in the other with low bushes of the same species. Further consideration of the relationships of this scrub is, however, deferred till later.

Gully Forests.

As was mentioned in an earlier part of this account, the Mount Lofty Range is penetrated by numerous ravines and gullies carved out by the erosive action of streams through long periods of time. Gullies have been cut both by the streams forming the drainage system of the ranges themselves and by rivers which rise on the eastern side of the watershed, but which have cut gorges right through the hills. Among the rivers which have cut through in this way are the Torrens and Onkaparinga. The gullies or gorges are generally deep and with steep sides. They have a moister atmosphere, or, at any rate, one in which the plants are exposed to less rigorous conditions.

These more favourable conditions are due to the presence of a stream only to a minor extent. Except for a very small number, the streams become dried up in summer; even the rivers may cease flowing and be represented by a series of pools. Factors of equal or greater importance are protection from wind and from the direct rays of the midday sun or from sunlight for many hours each day, all of which lead to a reduced evaporation rate. Another important factor is that such gullies receive a much greater and more constant precipitation of dew. This is the result of radiation and air drainage. About sunrise, especially in early Summer, it is no uncommon thing for the valleys to be saturated with moisture while the open slopes and ridges appear quite dry. Further, the soil in the gullies is finer grained, and not only more retentive of moisture, but, of course, receives the run-off after rains.

These various conditions combine to produce considerable differences in the forests which have a flora of a distinctly less xerophytic type. Many plants with relatively broad and thin leaves are present, and ferns and bryophytes are prominent here, though nowhere conspicuous, and often quite absent in the general forest.

While the forest is mainly composed of *E. obliqua*, in the deeper gullies *E. viminalis* is frequently present and may be locally dominant. Under trees occur here, too, though not in great quantity; both *Banksia marginata* and *Acacia melanoxylon* may assume the stature of small trees. In the undergrowth many of the epacrids and xerophytic *Proteaceae* and such plants as *Tetratheca, Hibbertia,* and others are absent or very much reduced in quantity. Their place is taken by *Dodonaea viscosa, Acacia verniciflua,* and many smaller plants, often broad-leaved, as *Senecio hypoleucus, Goodenia ovata, Spyridium parvifolium,* and *Correa speciosa,* with often very large quantities of *Pultenaea daphnoides,* which locally may form pure thickets. *Acacia myrtifolia* is very abundant, especially on broken rocky ground. *A. retinodes,* though mainly a stream-side plant, may spread out into the forest. Besides these, other characteristic plants are *Lepidosperma laterale, Hardenbergia monophylla,* with its broad shining leaves, and *Rubus parvifolius.* The last is an interesting plant, not only from the point of view of its distribution, but further because it is almost a true deciduous plant. *Pteridium aquilinum* is frequently very abundant in the gullies, becoming locally a dominant plant of the ground layer. This plant has here a much more xerophytic form than the bracken of N.W. Europe. It has evergreen leaves which are hard in texture with narrower, more distant, and entire segments. Its leaves, too, are almost glabrous on the upper surface and much less markedly deltoid. Another very common fern is *Cheilanthes tenuifolia.* In the gully forests there are also a considerable number of herbaceous plants which take a much more prominent part in the plant cover than is the case in the open. Among them

mention can only be made of a few: *Carex Gunniana, Acaena sanguisorbae, Geranium pilosum, Epilobium glabellum, Hydrocotyle hirta, Wilsonia rotundifolia, Helichrysum apiculatum*, and *H. lucidum*. *Adiantum aethiopicum* is a frequent plant on the ground, at times forming a carpet among mosses between the woody plants. *Asplenium flabellifolium* and *Gymnogramme leptophylla* are frequent on moist rock ledges, while *Pleurosorus rutaefolius* occurs on the drier rocks. *Blechnum discolor,* and occasionally *B. capense,* occur on moist rocks by waterfalls, and edge the banks of the streams.

Though many of the more xerophytic types occur also in the gullies the flora, as a whole, has a different appearance. It is greener and less sombre in appearance. Many of the herbaceous plants are quite mesophytic, or even hygrophytic. These, however, only flourish in the Winter and Spring, and become dried up later. The summer herbs are either very low-growing, as *Wilsonia* and *Hydrocotyle,* or are very hairy, as *Helichrysum.*

The distribution of these plants in the gullies varies greatly according to the aspect, the physiography, and other factors. The relation of the slopes towards the sun has a striking effect; the side of a gully receiving direct insolation has a much more xerophytic flora than that which is sheltered. Some plants show a most marked avoidance of direct sunlight, for example *Senecio hypoleucus,* which is often exceedingly abundant in the south facing slopes and entirely absent from the opposite ones. The mesophytic herbaceous flora only attains its full development in the most sheltered and moist situations, as on rock ridges and on banks just above the stream channel.

Except in the narrowest and most steep-sided gullies the flora described, which we may term the "gully flora," has a range restricted to the lower portions of the slopes. The limit of *Pteridium,* for example, often follows a contour line along the gully with considerable exactitude.

Gullies through Glacial Drift.

A few of the streams draining that part of the watershed which is covered by drift have cut channels sufficiently deep to be termed gullies. These have a vegetation that is strikingly different from the surrounding scrub; trees of *Eucalyptus obliqua* occur which are quite absent in the open (pl. xiii., fig. 2). On the slopes here occur large quantities of *Pultenaea daphnoides* and *Goodenia ovata* along with *Melaleuca decussata, Marianthus bignoniaceus,* and *Pteridium aquilinum,* but most of the more striking members of the gully flora proper are absent. At the heads of some of the gullies the drift has been removed by erosion, and on the exposed rock there are developed gully forests of *Eucalyptus fasciculosa,* in which the chief plants of the undergrowth are *Acacia myrtifolia, Goodenia ovata,* and *Xanthorrhoea semiplana.* These three plants compose about 80 per cent. of the undergrowth here.

Stream-side Communities.

Along the stream itself in the gullies there is developed a quite characteristic flora which, though ecologically separate from the forest, may be described at this point on account of their geographic relations.

Along rocky streams the characteristic plants are *Leptospermum lanigerum* and *Callistemon salignus,* which form thickets, 8-10 feet high in places, either lining a wide channel or completely covering a small one. These thickets are a striking feature, in summer especially, owing to the pale, almost white, colour of the young hairy leaves of the *Leptospermum.* Along with these two bushes there occurs *Acacia retinodes,* while below and among them are a number of smaller plants, as *Goodenia ovata, G. amplexans, Carex tereticaulis, Juncus pallidus,* and others.

In the case of the larger streams, where permanent pools of water occur, *Typha angustifolia* is plentiful. This occurs often alone, but is sometimes associated with *Phragmites communis*. *Cyperus vaginatus* is another common plant in stream beds which dry up in summer; it is especially abundant on sandy soils.

By springs on rocky soils, or where the stream flows over gravel or stones, a thicket of *Leptospermum lanigerum* and *Acacia retinodes* occurs in which the tall *Gahnia trifida* is very abundant. *Logania lanceolata* occurs locally here, though its more usual habitat is on wet sheltered rocks.

In those valleys where the stream becomes partially held up and the ground is swampy, at any rate during the Winter, *Phragmites* (often along with *Typha)* becomes abundant, associated with *Gahnia psittacorum* (pl. xiv., fig. 1). These plants build up a peat-like soil in which flourish *Blechnum capense, B. discolor,* and rarely, *Todea barbara*. The bushes occur largely towards the margins of such a swampy channel. Besides *Leptospermum lanigerum,* there occur *L. scoparium, Viminaria denudata, and Acacia verticillata,* all of which are very characteristic of this habitat.

In a few cases the gully has a flat bottom covered with silt or sand from the stream, and liable to be flooded in Winter. Where this occurs *E. rubida* is not infrequent along with or replacing *E. viminalis*. In the wetter portions of such valleys there is a thicket-like growth of *Leptospermum lanigerum,* with *L. scoparium, Acacia retinodes,* and *Viminaria denudata,* with *Gahnia psittacorum, Carex tereticaulis, Goodena ovata,* and a considerable number of smaller plants, among which may be mentioned *Juncus planifolius, Carex Gaudichaudiana, Rubus parvifolius,* with many others. These valleys are generally of small size. Larger swamp areas, where the ground water is more or less stagnant and the soil somewhat peaty, occupy locally not inconsiderable areas, but are developed and exist under conditions so different from those in the forest that they will be considered separately later.

"Box" (Eucalyptus elaeophora) Forests.

Forests allied to those of stringybark both in flora and in general form, but dominated by *Eucalyptus elaeophora,* the "bastard box" or the "peppermint," occur on the more northern part of the ranges. These forests extend a short distance southwards from the line of the gorge cut through by the River Torrens. They occur on hills composed of hard rocks, mostly of Pre-Cambrian age. These rocks are almost all highly metamorphosed and consist of hard schists, crystalline quartzites, or gneiss. They form hills with somewhat rugged outlines and produce shallow stony soils which are relatively fine grained but not sandy.

The dominant tree, *E. elaeophora,* is generally small in stature and has a great tendency to develop a "mallee"-like habit with two or more stems arising from the base (pl. xiv., fig. 2). Trees, however, of 60-70 feet in height have been noted. This tree reproduces very readily from seed and from stools after cutting. The juvenile foliage, whether of seedling or of coppice shoot, is exceedingly characteristic; the leaves are large, sessile, round, and very glaucous. Both colour and shape are in marked contrast to the adult foliage, and indeed very different from the foliage of any of the other eucalypts of the district. They form a most conspicuous feature of these forests, and recall in some ways the juvenile state of *E. globulus*.

Over the greater part of the area occupied by the "box" forests which we have examined the dominant *E. elaeophora* occurs alone as a pure forest. In the more rocky parts, however, *E. fasciculosa* forms a subsidiary or under tree, not one competing for dominance. *Casuarina stricta* occurs locally on rocky slopes where the soil is scanty.

The similarity of the undergrowth of these forests to that occurring in the stringybark forests is very marked; more especially is this the case with the drier stringybark forests. The chief differences, indeed, are in the absence of many species that occur in those previously described. The main plants of the undergrowth are *Hakea rostrata, H. ulicina, Leucopogon virgatum, Acrotriche serrulata, Astroloma Sonderi, A. humifusa, Tetratheca ericifolia, Platylobium obtusangulum, Xanthorrhoea semiplana,* and *Lepidosperma semiteres. Casuarina distyla* occurs occasionally, but was nowhere seen as an abundant plant. Two facies occur in this undergrowth; in the one case the Epacrids and Hakeas form the bulk of the flora, while in the other *Lepidosperma semiteres* becomes exceedingly abundant (pl. xv., fig. 1), giving the appearance from a distance of a grassy undergrowth. The smaller associated plants are also those of the stringybark forests, *e.g., Scaevola microcarpa, Brunonia australis, Helichrysum apiculatum, Halorrhagis tetragyna, H. ceratophylla, Drosera Menziesii, Danthonia penicillata, Dichelachne sciurea, Dichopogon strictus,* and others.

On the lower slopes a sparser and more open undergrowth is present, in which *Acacia pycnantha* may be present in some quantity along with *Hibbertia sericea, Olearia tubuliflora, Halorrhagis tetragyna, Astroloma humifusa, Goodenia geniculata, Danthonia penicillata,* and others. This flora is very much like that already described for the *E. obliqua* forests at the lower levels. On very steep rocky slopes, again, woodlands almost exactly like those already described occur which are composed of either *E. fasciculosa* or *Casuarina stricta* and *Xanthorrhoea quadrangulata. E. elaeophora,* however, appears able to grow and to hold its own on more rocky and shallower soils than does *E. obliqua,* and frequently occurs along with the pink gum. The gullies and valleys cut out in these rocks are, for the most part, wider and more open than those in the Cambrian series of rocks and the characteristic gully flora is not much developed. In some cases, however, as, for example, in the gorge of the River Torrens, the undergrowth is characterised by quantities of *Correa speciosa* which may assume dominance in the second layer. *Senecio hypoleucus,* again, is very abundant on steep rocky slopes facing south. By the streams themselves, which, however, are few in number, exactly the same stream-side flora occurs as in the forests already described. Indeed, the relations of the two types of forest are evidently very close indeed. They have not only closely similar floras, but they occur on corresponding situations, *E. obliqua* forests on the Cambrian quartzites and *E. elaeophora* forests on the metamorphic rocks of Pre-Cambrian age. The differences in flora all point in the direction of there being less water available in the forests of *E. eleaeophora.* The importance of this factor of drought is further emphasised by the reported presence of *E. obliqua* in some of the gullies. We ourselves have not seen an actual example of this, but are informed of it by residents in the district who are certainly able to differentiate between the two trees. It has already been noted that in gullies in the dwarf scrub region at Mount Compass *E. obliqua* trees occur, so that the relations of the box forests on the one hand, and the scrub on the other, to the stringybark would appear quite parallel.

The increased dryness is not the result of a decrease in rainfall; nearly all the Precambrian "massif" lies within the 30-inch line and some reaches 35 inches. But the part of the ranges on which the box forests occur is further removed from the sea, and it may be expected that less moisture is brought by the south-west winds. It is certainly noticeable that in Winter mists on the ranges are more frequent from Mount Lofty southwards than they are further north. This decrease in mist and cloud inducing a drier atmosphere on these very shallow silicious soils would appear to be a differentiating factor between forests of *E. elaeophora* and *E. obliqua.* Another factor that may enter into the question

is that *E. obliqua* is here at the western limit of its geographical range. It is well known that many species are much more exacting in their habitat requirements under such conditions. The elucidation of the exact differentiating factors separating the two forests which are undoubtedly very closely allied can only be made complete by detailed quantitative work in the field. It is a question that demands attention not solely from its scientific interest, but also from the practical standpoint. *E. obliqua* is a relatively valuable timber tree, while *E. elaeophora,* being smaller and slow growing, is much less profitable. It might well be advisable to make some attempt to conserve or even increase the area of the former. But with the data at present available it is not possible to go further into the matter.

2. Blue Gum (Eucalyptus leucoxylon) Forests.

Forests of the blue gum, *E. leucoxylon,* cover for the most part the lower hills, foothills, and rolling country on either flank of the main range. They occur on soils formed from slates, phyllites, schists, and limestones of the Cambrian series which lie within the region of 25-35 inch annual rainfall. Most of this country has between 27 and 30 inches. The soils vary considerably in composition but are all relatively deep and fine-grained, not sandy. As compared with the soils derived from quartzites or Precambrian rocks they are relatively rich in bases. The topographic features are also different in relation to the softer rocks; the slopes are much less steep and not rugged, the contours and general outlines are rounded (pl. xv., fig. 2).

The forests that occur on these soils are of a very different type from those described above. The canopy is even more open; in many cases, indeed, the trees stand quite apart from one another, giving a park-like effect. The ground vegetation is essentially herbaceous and grass-like in general appearance.

The characteristic tree is *E. leucoxylon,* the blue gum, which, with its white stems and open growth stands out in strong contrast to the stringybark even at long distances. Besides the blue gum, *E. viminalis,* manna gum, is frequent, especially in the regions of higher rainfall and in gullies. *E. rubida,* white gum, occurs in valleys, but is local, and its distribution is considered later. The red gum, *E. rostrata,* though, strictly speaking, a tree of the valley bottoms, frequently spreads out into the blue gum forests. *Casuarina stricta* occurs scattered through the forests and becomes abundant or even locally dominant where the rock is near the surface. This tree is much more abundant in these forests than it is in those of stringybark.

Undershrubs are not generally conspicuous and practically never form a continuous layer. *Acacia pycnantha* is the most prominent, and is never absent except in the regions of lowest rainfall (pl. xvi., fig. 1). This plant is at times very abundant, forming an almost continuous layer, but this condition seems always the result of modification. The plant is encouraged and at times sown owing to its value for bark. It is treated in some of the woods in a manner quite analogous to the encouragement of hazel in oak woods in Britain. Other shrubs which occur here are *Olearia tubuliflora,* the parasitic *Exocarpus cupressiformis,* with *Xanthorrhoea semiplana, Dodonaea viscosa, Bursaria spinosa,* and others more locally.

As mentioned the ground vegetation is herbaceous, but its grass-like appearance disappears on closer examination; true grasses form quite a small proportion of the plant population, which consists of a variety of dwarf shrubs, herbs, and annuals. The form of the ground cover is in marked contrast to that in the stringybark forest, a contrast that is further emphasised by the fact that here the vegetation is largely seasonal. With the exception of some of the shrubby species the whole become dried up in the summer season. Among the most abundant

and generally distributed plants are: *Hibbertia acicularis* and *H. sericea,* which together form the major portion of the cover in Winter. Along with these are *Astroloma humifusa, Acrotriche serrulata,* and, more locally, *Tetratheca ericifolia, Daviesia corymbosa, D. ulicina, Dillwynia hispida, Leptospermum myrsinoides,* and others. These are all shrubby, and along with and sometimes to the exclusion of them occur numerous herbaceous plants, among which may be mentioned: *Leptorrhynchus squamatus, Vittadinia australis, Helichrysum apiculatum, Cymbonotus Lawsonianus, Scaevola microcarpa, Goodenia geniculata, Velleya paradoxa* (local), *Brunonia australis, Halorrhagis tetragyna, H. ceratophylla, H. teucrioides, Linum marginale, Acaena ovina, Caesia vittata, Bulbine bulbosa, Dichopogon strictus, Anguillaria dioica, Schoenus apogon, Carex breviculmis, Themeda triandra, Danthonia penicillata, Stipa scabra, S. eremophila, S. semibarbata.* Of these *Acaena ovina* is generally very abundant, and along with *Danthonia, Leptorrhynchus,* and *Scaevola* forms a large part of the herbaceous flora. Other plants common but rather less abundant are *Convolvulus erubescens, Ajuga australis, Eryngium rostratum,* and others. Orchids occur in some variety in these forests, especially in the moister parts. Among the commoner are *Diuris longifolia, D. pedunculata, Thelymitra aristata, Corysanthes fimbriata, Pterostylis nana, P. nutans, Acianthus exsertus, Caladenia deformis, C. carnea.*

These open forests have been invaded, to a much greater extent than occurs in those described above, by alien plants. Some of these have now come to occupy a definite place in the vegetation and have penetrated far beyond the region of direct interference by man. The most noteworthy are three annual grasses: *Briza maxima, B. minor,* and *Aira caryophyllea,* while *Bromus maximus* is a little more restricted.

Annuals generally are abundant. Very generally distributed species are: *Flaveria australasica, Brachycome diversifolia, B. trachycarpa, Lagenophora Billardieri, Helichrysum scorpioides, Sebaea ovata,* and *Wahlenbergia gracilis.* In valleys and places where the soil is wet in Winter and Spring a number of ephemeral annuals occur, *e.g., Brizula pumilio, Centrolepis aristata, Hydrocotyle callicarpa,* and *Rutidosis pumilo,* with several others.

Parasites, and especially *Loranthus Miquelii,* are abundant. *L. Miquelii,* indeed, may be so abundant that trees of *E. leucoxylon* may be much impoverished or even killed out. *L. exocarpi* is less common. *Cassytha melantha* occurs locally in great quantity.

In these blue gum forests the distribution of the undergrowth varies a good deal with changes in topography and soil. On the lower slopes and on northern exposures the larger shrubs are almost absent, the flora being composed of *Hibbertia* with herbaceous plants and grasses. Geophytes, for example *Microseris Forsteri, Drosera Whittakeri,* many Liliaceae and orchids, are only abundant in sheltered situations which are moist in the Spring. Slopes with a southern exposure often abound in shrubs, especially *Acacia pycnantha,* while on the ground *Cheilanthes tenuifolia* is prominent, and *Pteridium aquilinum* may approach dominance towards the bottoms of valleys. On ridges running east and west there is often a marked difference in the flora on the two sides; that facing north has few or no shrubs and a ground cover which is essentially herbaceous and becomes quite burnt up and brown in summer, while on the opposite slope, facing south, the trees are closer together, *E. viminalis* often occurs along with *E. leucoxylon,* and a more or less definite layer of *Acacia pycnantha,* with some *Exocarpus* and *Bursaria spinosa,* is present. On the ground are many geophytes and *Cheilanthes tenuifolia;* these dry up in summer, but do so much more slowly, and the vegetation through most of the year appears much less parched.

On the tops of broader ridges and in relatively level parts *Acacia pycnantha* becomes especially abundant. On the uppermost ridges, which have a shallower soil and which are liable to a longer and more frequent drought, a more xerophytic facies in the ground flora occurs. Many undershrubs are present, such as *Hibbertia, Tetratheca, Astroloma,* and *Acrotriche.* In parts of the ranges there are steep rocky slopes on which *Casuarina stricta* is abundant, sometimes to the exclusion of Eucalypts. With it occur some quantities of *Xanthorrhoea quadrangulata* and *X. semiplana.* Such slopes form a locality for *Callitris cupressiformis,* var. *tasmanica.* This plant, which forms a bush rather than a tree, is not generally distributed, but usually occurs in circumscribed groups in which the individuals may be close together and exclude other vegetation. At other times the *Callitris* bushes are separated from one another.

Owing to the open character and to the type of undergrowth these forests of *E. leucoxylon* are less liable to damage by fire than are those of *E. obliqua.* Fires do occur from time to time, though their effects are much less pronounced. Occurring as they do in the Summer, when most of the ground plants are dormant, little damage is done and, owing to the absence of shrubby undergrowth, the trees are rarely affected. Fires apparently assist the spread and seeding of *Callitris.* In those portions where *Acacia pycnantha* is abundant a bush fire has a more marked result. *Acacia* is a plant whose germination is stimulated by fire, and afterwards it appears in increased quantity. Immediately following the fire *Ixodia achilleoides* becomes temporarily abundant, though to a much less extent than it does in the stringybark forests.

In some parts forests of blue gum adjoin those of stringybark. Where this occurs the transition from one to the other may be abrupt or more gradual. The former case is especially striking, a sharp line dividing the two; on the one side *E. obliqua,* with its dark stems and dense xerophytic shrubby undergrowth, and on the other the white stems of the *E. leucoxylon,* with the herbaceous ground cover. But while this abrupt transition does occur, in very many cases there is a zone of mixed forest that may be many yards across. This mixed forest has a rather open undergrowth, with *Acacia pycnantha, Hibbertia acicularis, Tetratheca ericifolia, Leucopogon virgatum,* and others as the most prominent plants.

In the region studied where the rainfall is rather high the determining factor differentiating the two types of forest is edaphic, but other factors must also be recognised, as will be shown later when the relationships of the communities are discussed.

Ironstone Soils.

The rather basic soils upon which blue gum forests grow may become impregnated with iron just as occurs with the quartzites. The ironstone is, however, less common and occurs over less extended areas. The ironstone is either in the soil or subsoil, or else the rock itself is an ironstone, in which case a very shallow soil results. In either case the flora changes and a more xerophytic facies occurs which comprises a much greater number of shrubby plants. Undershrubs, indeed, may become dominant and an undergrowth occurs which is very similar to that of the stringybark forest.

Where there is an ironstone soil heath-like undershrubs become abundant; the most prominent are *Grevillea lavandulacea, Leucopogon virgatum, Acrotriche serrulata, Leptospermum myrsinoides, Tetratheca ericifolia,* along with *Hibbertia acicularis, H. sericea,* and *Xanthorrhoea semiplana.* Locally taller undershrubs occur, such as *Hakea ulicina, Casuarina distyla, Astroloma Sonderi,* and others. *Acacia pycnantha* is here scarce and annuals, like many of the herbaceous plants, are much less abundant or absent.

On the very shallow soils formed from the ironstone rock the trees are small and stand at long distances apart. The trees here are very much infested with *Loranthus Miquelii*, which is rarely absent from any approaching maturity. The undergrowth is a rather dense scrub of bushes rising 2-4 feet; *Casuarina distyla* is the most abundant, but with it occur considerable quantities of *Xanthorrhoea semiplana, Hakea rugosa, H. ulicina, Isopogon ceratophyllus, Calythrix tetragona, Leptospermum myrsinoides, Lissanthe strigosa,* and others. Among these shrubs occur *Neurachne alopecuroides, Helichrysum Baxteri, H. scorpioides, Leptorrhynchus squamatus, Kennedya prostrata,* and other small plants. This undergrowth is very much like that which occurs in the stringybark forest on ironstone, but has several points of difference: *Hakea rugosa* takes the place of *H. rostrata,* many plants of the stringybark forest are missing, and some others are here more prominent.

These ironstone areas with their shrubby xerophytic undergrowth are much affected by fires. After burning, flowering and increase of *Xanthorrhoea semiplana* occurs just as was described earlier; *Ixodia achilleoides,* however, is here quite a local plant. A considerable number of small plants become much more prominent after a fire, though none of them become very abundant; among them are *Stipa eremophila, Danthonia penicillata,* and *Helichrysum Baxteri.* The orchid *Lyperanthus nigricans* which occurs here seems only able to produce flowers after a fire. Among the shrubs *Calythrix* and *Leptospermum* increase after burning, both from seed and owing to their rapid regeneration.

Gully Forests.

The gully and stream-side forests, which are such a feature of the watercourses in quartzite rocks, are here poorly developed owing to the softer rock giving a different topography. The flat bottoms of the larger valleys are occupied by woodlands of *Eucalyptus rostrata,* which are described later separately. On valley sides the flora is often hardly distinct from that described above. *E. viminalis* is generally more abundant. Where shelter is obtained shrubs are more abundant, especially *Acacia pycnantha,* with *Bursaria spinosa* and *Dodonaea viscosa. Banksia marginata* is here almost entirely a valley plant. Among characteristic ground plants in the moister places are *Arthropodium paniculatum, Carex Gunniana, Juncus pallidus, Goodenia amplexans* and *G. ovata,* and others.

Savannah Forest.

On the somewhat undulating country on the east side of the ranges there occurs a savannah-like forest that differs in some ways from the blue gum forests described above. The trees here form a very open forest; they stand isolated or in groups with many clear spaces and glades. The trees are principally *E. leucoxylon* and *E. viminalis* (pl. xvi., fig. 2). *E. rostrata* occurs in the valleys but extends out from them to a considerable extent, often becoming mixed with the other species. *Casuarina stricta* grows on rocky outcrops. *E. leucoxylon* occurs here in two forms, the common white-flowered plant and one with red flowers, which apparently does not differ in other respects. Shrubs are almost wholly absent from these woods; a few scattered plants of *Acacia pycnantha* occur which sometimes rise to the stature of small trees, but these are never at all abundant.

The ground flora is herbaceous and grass-like; it becomes very much dried up and burnt yellow in Summer. The most abundant plants are *Acaena ovina, Danthonia penicillata, D. carphoides, Stipa scabra, S. eremophila,* and *Vittadinia australis,* with several others in less quantity, as *Hibbertia sericea, Pimelea glauca, P. humilis, Astroloma humifusa, Wahlenbergia gracilis, Convolvulus erubescens,*

Leptorrhynchus squamatus, Dichopogon strictus, and *Bulbine bulbosa.* Much less abundant but very generally distributed plants are: *Flaveria australasica, Lagenophora Billardieri, Brachycome trachycarpa, Hypericum japonicum,* and *Halorrhagis tetragyna.*

On the rocky outcrops, on which *Casuarina* occurs to the exclusion of the Eucalypts, the undergrowth is very sparse but of the same character. A few plants such as *Halorrhagis ceratophylla, Scaevola microcarpa,* and stunted *Cheilanthes tenuifolia* occur here, but not in the general woodland.

Practically the same flora occurs in the open valleys under the trees of *E. rostrata.* In addition to the plants named, isolated clumps of *Juncus pallidus,* which may reach a very considerable size, occur; *Schoenus apogon* and *Drosera peltata* are locally abundant. Several moisture-loving ephemerals grow here, among which may be mentioned *Centrolepis aristata, Drosera glanduligera, Hydrocotyle callicarpa,* and others.

In some parts deeper valleys have been cut out, and in these there is a richer flora. *Leptospermum myrsinoides* may be abundant, and along with it *Acacia obliqua, Thomasia petalocalyx, Grevillea lavandulacea, Bursaria spinosa, Trichinium erubescens,* and others may be found. Locally *Xanthorrhoea semiplana, Lepidosperma semiteres,* and *L. viscosum* occur in some quantity along with *Lomandra (Xerotes) dura,* and others. Where the trees have been felled some of these plants, and especially *Lepidosperma,* may become exceedingly abundant, so much so indeed as almost to exclude the grassy undergrowth.

3. Manna Gum (Eucalyptus viminalis) Forests.

Forests composed of *E. viminalis,* manna gum, either alone or with some admixture of other species, occur rather locally in valleys and on gentle slopes where the soil is a deep and loose and rather fine-grained sand. The forests on sand are rather open in character, with *E. viminalis* as almost the only tree species. *E. rostrata* may be present in the bottoms of the valleys, and occasional trees of *E. leucoxylon* occur on the slopes. *Banksia marginata* is abundant here as an under tree and in open spaces, or when trees have been cut out, may form quite dense thickets. Otherwise the undergrowth is composed of dwarf shrubs and herbs. Of the undershrubs Hibbertias are much the most abundant, *H. sericea, H. virgata,* and *H. stricta* are common, while *H. acicularis* is occasional. Other plants are *Leptospermum myrsinoides, Isopogon ceratophyllus, Platylobium obtusangulum, Dillwynia hispida, Tetratheca ericifolia,* and others. These shrubs form an open cover, standing at some distance apart from one another, and not or very rarely in contact. Among the most prominent of the herbaceous and smaller plants that occupy the spaces are *Stipa scabra, Lepidosperma carphoides, Helichrysum scorpioides, H. Blandowskianum, Brunonia australis,* and others. These manna gum woodlands on sandy soils show a fairly rapid power of regeneration; young trees are of frequent occurrence, and after cutting or ringbarking the forest is soon re-established if left undisturbed. After cutting, *Banksia* spreads very rapidly for a time, but soon becomes subsidiary to the stronger-growing taller Eucalypts. However, should an almost continuous layer of *Banksia* occur in these woods it can be taken as evidence of previous interference with the tree canopy.

E. viminalis also forms pure woodlands on another type of habitat, namely, towards the head of some of the gullies running into the hills. Here the woods occur just below the region of the stringybark forests. Such local forests represent what is apparently a gully forest of the blue gum type. Occasional trees of *E. leucoxylon* are present, and also some of *E. obliqua,* in the upper parts. Under trees and bushes are scattered, and do not form a continuous layer; *Acacia*

melanoxylon, A. pycnantha, Bursaria spinosa, Dodonaea viscosa, and *Banksia marginata* are the chief plants. The undergrowth is generally herbaceous, *Cheilanthes tenuifolia* is abundant, along with *Danthonia penicillata, Stipa scabra, Bulbine bulbosa, Ajuga australis,* with *Pteridium aquilinum* very abundant or even dominant towards the bottom of the slope. On very sheltered, steep, south-facing slopes *Acrotriche fasciculiflora* may be abundant or even locally dominant. Bryophytes are generally prominent in these woods.

The forests of *E. viminalis* are closely allied both in structure and flora to those of *E. leucoxylon.* The main difference appears due to increased moisture, in the first type described (that on deep fine sands) to moisture in the soil and in the second to moisture due to the shelter of a gully. As has been noticed, *E. viminalis* is commonly associated with *E. leucoxylon,* and it appears to become the dominant to the exclusion of the latter under moister conditions.

4. White Gum (Eucalyptus rubida) Forests.

E. rubida, white gum or "candlebark," locally forms almost or quite pure forests on parts of the hills where the rainfall is 30 inches or more. The ground is undulating, with small valleys between low ridges. The white gum forests occur at and around the heads of these valleys. The form of the woodland depends to a considerable extent on the age of the trees. *E. rubida* is a tree attaining a considerable size, 100-150 feet or more, and when mature is a marked light-demander, so that woodlands composed of old trees are very open, the trees standing at long distances apart. Seedlings and young trees, however, come up in the spaces in great numbers, and quite dense woodlands occur composed of trees with poles of 1-1½ feet diameter. *E. rubida* may occur pure or in association with *E. leucoxylon.* Generally in the valley depressions it is in pure stand, but on the slopes the latter tree occurs mixed with it (pl. xvii., fig. 1).

Acacia pycnantha occurs in the undergrowth but is not abundant. The ground cover consists of *Hibbertia acicularis* with *Tetratheca ericifolia, Acrotriche serrulata,* and many herbaceous plants; *Pteridium* occurs, but is local, as also is *Leptospermum myrsinoides.* The flora is indeed practically that described for the forests of *E. leucoxylon.*

E. rubida is a tree that makes considerable demands on the soil for water. Its presence has already been noted in the stringybark forests by creeks in flat-bottomed valleys. It is a characteristic tree of swamps which will be described later. In the woods just described the abundance of the tree and its spread out from the valleys is correlated with the presence of a water-retaining soil occurring on slight slopes with a high rainfall. Its spread and abundance here have almost certainly been assisted by human interference; *E. leucoxylon* forms a much more valuable timber than *E. rubida,* and preferential cutting undoubtedly assists the spread of the latter both by removal of competition and of trees from which seed for regeneration is supplied. These forests of *E. rubida,* with almost the same flora as those of *E. leucoxylon,* are certainly largely produced semi-artificially in this way. How far and how long they would be able to maintain themselves if left alone cannot at present be stated.

5. Peppermint (Eucalyptus odorata) Forests.

On the foot-hills and on the upper margin of the plains there are forests which have much in common with the blue gum forests, but which are dominated by a wholly different tree, namely, *E. odorata,* peppermint or box (pl. xvii., fig. 2). This is generally a small tree, not often reaching more than 50 feet in height. It has a great tendency to develop several stems from the base and frequently occurs as a large mallee. This tree has a dark bark and dark dull-

green foliage, in both of which characters it forms a strong contrast to *E. leucoxylon.*

At the present time the area occupied by peppermint forests has been very much reduced as compared with the primeval condition. The forests, too, which remain have been in most cases considerably modified by cutting, pasturage, and other human activities.

These forests occur on relatively deep basic soils which have the general feature of being very retentive of water in winter, becoming in many cases more or less waterlogged, while in summer they become baked hard and dry. The soils are very similar to those occupied by the blue gum forests, but are as a rule more friable and less caked in the dry season. It does happen, however, that blue gum forests cover the top of a slope the lower portions of which are clothed by peppermint. *E. odorata* generally forms pure open forests. The tree has great power of regeneration from the stool after cutting, but does not spread from seed rapidly. *Casuarina stricta* occurs scattered through the forest and is abundant in the driest parts where the soil is shallow (pl. xix., fig. 1). Locally on dry sunny slopes small trees of *Pittosporum phillyraeoides* occur, but are never at all numerous. Shrubs are not generally abundant; on the lower drier parts they are often absent, but at higher levels *Acacia pycnantha* is abundant. As in the case of blue gum forests, the plant is in parts encouraged and sown. In not inconsiderable stretches where such sowing has occurred and Eucalypts have been felled the forest has been replaced by a bushland of *Acacia pycnantha.* Other shrubs are of infrequent occurrence.

It may be mentioned here that parasites are not abundant in these forests; *Loranthus* is rather rare on *E. odorata. Cassytha melantha* is quite local and *Exocarpus* is by no means frequent.

The ground vegetation varies considerably in different parts; on slopes where the soil is not often saturated in Winter a considerable variety of herbs make up a cover in which grasses or grass-like plants take a considerable part (pl. xvii., fig. 2). The most abundant tree grasses are *Danthonia penicillata, Stipa scabra,* and *S. eremophila,* together with the ubiquitous introduced grasses *Briza maxima, B. minor, Bromus maximus, Aira caryophyllea,* and *Festuca bromides.* Along with these are *Dichopogon strictus, Burchardia umbellata, Anguillaria dioica,* and, less often, *Bulbine bulbosa.* The most abundant dicotyledons here are *Scaevola microcarpa, Brunonia australis, Leptorrhynchus squamatus, Halorrhagis tetragyna,* and others. The low undershrubs *Hibbertia acicularis, H. sericea, Pimelea glauca,* and *Astroloma humifusa* occur scattered through and are most frequent in the driest spots. In early Summer *Flaveria australasica, Sebaea ovata,* and some other annuals are abundant.

On rather level ground and flats where the soil is saturated through much of the Winter there occurs a flora in which geophytes take a considerable share along with, in Spring, a number of ephemerals. Here *Hibbertia sericea* and *H. stricta* are generally frequent. Of the geophytes the most prominent are *Hypoxis glabella, Chamaescilla corymbosa, Burchardia umbellata, Caesia vittata, Bulbine bulbosa, Caladenia deformis, C. dilatata, C. Patersonii, Diuris pedunculata, D. longifolia,* and other species of orchids, *Drosera Whittakeri, D. peltata, Microseris Forsteri,* and others. Two very interesting geophytes here are the lycopods *Isoetes Drummondii* and *Phylloglossum Drummondii,* which were discovered in South Australia by Osborn, who first described this type of community (1918). Among the ephemerals noticeable forms are *Hydrocotyle callicarpa, Rutidosis pumilo, Quinetia Urvillei, Stylidium calcaratum, S. despectum, Centrolepis aristata, C. strigosa, Brizula pumilio,* and several others. In this community *Schoenus apogon* is abundant and may locally form a turf. In the wettest parts occurs *Polypompholyx tenella.*

On these wet flats the peppermint is mixed with some *E. rostrata* and *E. leucoxylon*, the latter in less quantity (*c.f.* Osborn, 1918, pl. i., fig. 1).

A most complete contrast to this type of forest on the flats is provided by that developed where ironstone is present. The ironstone here forms a "pan"-like layer in the soil and causes a change to a shrubby xerophytic flora in which the following are prominent: *Leptospermum scoparium, L. myrsinoides, Lissanthe strigosa, Astroloma humifusa, Hibbertia sericea, H. acicularis, Olearia tubuliflora,* and others. *Acacia pycnantha* is usually present. When ironstone rock is present *E. leucoxylon* and the type of forest described earlier occurs.

On the lower slopes and on the upper limits of the plains the forests of *E. odorata* have been so modified that the ground flora is composed now wholly of introduced plants which have completely driven out the native species and absorbed their place. These semi-artificial communities are considered later. Remnants of peppermint forests occur extending on to the Adelaide plains, which, probably, were originally covered with open "savannah forests" of this tree. At present the native undergrowth has wholly disappeared and has been replaced by weeds and aliens. In some relics of the forest that still exist near the sea, trees of *Melaleuca parviflora* are present and *Cladium junceum* may be abundant on the ground.

E. odorata forests form a roughly-marked zone at the foot of the ranges, while *E. leucoxylon* forms a zone higher up. The line of junction of the two is often quite sharp. The differentiating factors, which are considered more fully later, appear to be partly edaphic and partly climatic. On the Mount Lofty Ranges the climatic zones are so close together and so narrow that the influence of each is somewhat obscured. However, on the hills 50 to 100 miles north of Adelaide the climatic differentiation of the two becomes much more clear. There *E. leucoxylon* forests are confined to the larger hills with a rainfall of 22-25 inches or more, while *E. odorata* clothes the foot-hills and wide valleys which receive less rain.

6. Red Gum (Eucalyptus rostrata) Forests.

The red gum, *E. rostrata,* is one of the most widely-distributed species of *Eucalyptus* in Australia, and also one with very marked characteristics of habitat. It occurs on diverse types of soil, but in all cases in situations where a considerable supply of underground water is present for the roots. It is essentially a riverside and valley bottom tree. In the area under consideration at present, it occurs by rivers and creeks where a moist soil is provided (pl. xviii., fig. 1) and also on flats where water is retained. In the last case quite considerable areas of forest may occur, whereas in the former the red gum grows rather as a fringe along the river or stream. On all the soils described, wherever a broad-bottomed valley or a flat with permanent, or relatively permanent, ground water occurs *E. rostrata* is present. Such situations are found in the flood plains of streams, the upper parts of valleys with slight fall, and the collecting grounds of streams. The soil varies considerably but is typically deep and with a fair proportion of fine-grained constituents. Gravel, however, may be abundant.

E. rostrata becomes a large tree with a spreading habit, and, like so many other members of the genus, is very intolerant of shade. It forms open forests, but, owing to its extremely ready regeneration from seed, a good cover is produced. In untouched forests, wherever a gap occurs, groves of seedlings and small trees appear and form quite dense groves of young trees. *E. rostrata* occurs, as a rule, quite pure. Undertrees are not abundant; *Acacia melanoxylon* is present but only in small amount, *Banksia marginata* is very local. Shrubs are also few both in number and in variety of individuals; *Leptospermum scoparium* is

not infrequent but scattered; *Bursaria spinosa, Dodonaea viscosa, Acacia retinodes,* and others occur locally. The undergrowth is for the most part herbaceous or of small plants. Along stream channels, or in depressions where most water is present, large herbs may grow abundantly, as: *Juncus pallidus, J. polyanthemos, J. pauciflorus, Carex tereticaulis, Gahnia psittacorum,* with *Patersonia longiscapa* in the wettest spots. Other plants are *Goodenia ovata, G. amplexans, Acacia spinescens, A. verticillata,* and others. *Villarsia reniformis* occurs in ditches and pools.

The main ground cover consists of small herbaceous plants with many geophytes and ephemerals. The flora, in fact, is very like that mentioned in the *E. odorata* forests on flats. Such plants as *Isoetes Drummondii, Chamaescilla corymbosa, Dichopogon strictus, Schoenus apogon, Drosera Whittakeri, D. auriculata,* and *Hypoxis glabella* may be abundant. Locally *Carex Gaudichaudiana* may form a turf. In those parts, where the surface soil is very dry in Summer, the flora scarcely differs from that of the surrounding woodland. Indeed, apart from the absence of shrubs, such as *Acacia pycnantha* and others, very little change occurs in passing from a forest of *E. leucoxylon,* or of *E. odorata,* to one of *E. rostrata* by a creek till the creek itself is reached. The number of ephemerals increases and a few moisture-loving plants appear, but many of those generally inhabiting drier situations persist. The reason for this rather slight change of flora lies in the fact that the surface layers in which the ground plants are rooted becomes parched in Summer, just as do those of soils without deeper water supplies. The red gum trees penetrate to the deeper water stores, consequently the conditions for the trees and for the herbs are very different in summer time. *E. rostrata,* however, spreads out to some extent from these typical habitats. This is especially the case in the rolling "savannah" country to the east of the ranges.

In the more mountainous parts, where the valleys are narrower and have steeper sides, flat alluvial plains are not formed. *E. rostrata* here can hardly be said to form a forest; it grows along the line of the creek wherever any water-holding soil occurs. In the upper regions, where less and less soil is formed, its place is taken by *E. rubida* or *E. viminalis.*

In the plains the same relations hold; *E. rostrata* forms forests by streams and on low-lying marshy land. In the Adelaide suburban district, where these situations have been much altered by settlement and forests destroyed, *E. rostrata* is still the commonest indigenous tree.

7. Swamps.

Swamps in which the soil is permanently wet are local, but some good examples occur in the district. They occur on some river flats, in certain hill gullies where water run-off is prevented, and at the head waters of streams rising in the Permo-carboniferous glacial deposits. The soil in these swamps is not only permanently wet, but is in some cases largely or entirely built up of plant remains which form a black rather structureless peat. The more peaty swamps in the hills have had their vegetation largely or completely destroyed on account of the value of the land for the cultivation of fruit and vegetables. There still remain, however, some examples which are almost untouched.

Silt Swamps.

The vegetation in the swamps varies greatly and can be correlated with several factors, among the most striking of which is the presence or absence of inorganic silt in the soil (Pearsall). When the soil is essentially a mineral one, with organic matter diffused through it as humus, trees are present. *E. rubida*

is the chief one (pl. xviii., fig. 2), though *E. rostrata* occurs where the ground water is not stagnant. These trees are scattered and do not grow close enough to form a woodland community. The vegetation other than trees has the form of a dense growth 3-6 feet in height, consisting of *Leptospermum scoparium* with *Acacia retinodes, A. verticillata, Viminaria denudata.* The undergrowth contains a great variety of species, prominent among which may be mentioned: *Patersonia longiscapa, Cladium junceum, C. tetragonum, Schoenus brevifolius, Juncus planifolius, J. pauciflorus, J. holoschoenus,* and *Calamagrostis quadriseta.* Along with these occur *Ranunculus lappaceus, Microseris Forsteri, Chamaescilla corymbosa, Burchardia umbellata.*

Small plants including ephemerals are abundant: *Drosera peltata, D. auriculata, D. Whittakeri, Hydrocotyle callicarpa, Schoenus apogon, Centrolepis aristata, C. strigosa, Microtis atrata, M. parvifolia.* In depressions where the vegetation is not continuous there occur *Drosera pygmaea* and *Stylidium despectum. Centrolepis strigosa* especially may be very abundant. In the driest parts, around bushes, there occurs *Bossiaea prostrata* in some quantity, also *Dillwynia hispida, Halorrhagis tetragyna, Adiantum aethiopicum,* and some others. Here, also, there are small plants of *Hakea ulicina, Banksia marginata, Pimelea glauca,* and some other invaders from forests. Such plants do not seem able to establish themselves completely and die down after reaching a certain quite limited size. They appear to be woodland plants which attain access to the new habitat but find it unsuited to them.

Some examples have been seen in which these silt swamps have been cleared and subsequently abandoned. In this case regeneration of the vegetation occurs rather quickly. At first the community is predominantly herbaceous, the most prominent plants being *Cladium junceum, Juncus planifolius, J. holoschoenus,* and *Patersonia longiscapa.* Associated with these are most of the plants found in the *Leptospermum* swamps; *Centrolepis strigosa* becomes exceedingly abundant along with *Leptorrhynchus squamatus, Carex Gaudichaudiana,* and other plants that occur especially in the more open parts of the mature swamp. A few plants from drier situations penetrate at this stage, notably *Themeda triandra, Poa caespitosa,* and *Kennedya prostrata.* However, seedlings of *Leptospermum, Viminaria,* and *Acacia verticillata* soon appear and rather rapidly assert themselves to reattain dominance over the community.

Peat Swamps.

As a complete contrast to the silt swamp, one with a pure peat soil will next be considered. Good examples are found in the depressions between the low ridges covered with glacial deposits in the Mount Compass region. The largest swamp here is that known as Square Water Hole. The soil here is a peat which is quite black, rather fibrous, but with a soapy feel. The preservation of structure is very poor. This peat may attain a thickness of several feet. The soil is saturated all through the Winter, and even in Summer is quite wet a few inches below the surface. In Winter, indeed, much of the surface is under water, only the highest portions standing out. The vegetation consists of a varied assemblage of plants, among which monocotyledons of rush-like habit predominate. The great mass of it is composed of *Cladium junceum, Schoenus brevifolius, Xyris operculata,* and *Sprengelia incarnata,* with an undergrowth of *Hypolaena lateriflora, H. fastigiata, Leptocarpus Brownii,* and *Lepidobolus drapetocoleus.* In the drier, more elevated portions *Lepidosperma exaltatum, Leptospermum scoparium,* and *Epacris impressa* become abundant. This swamp provides the habitat for a number of interesting plants, among which mention may be made of *Lycopodium laterale, L. carolinianum, Schizaea fistulosa, Lindsaya linearis, Utricularia lateriflora,* and *Levenhookia dubia.*

A moderately complete story of the building up of surface peat in this type of swamp can be made out. Starting from hollows that are bare peat and under water all Winter, we can trace the development to the driest parts where *Leptospermum scoparium* flourishes. The first plants to appear on the bare peat are *Microtis atrata, Levenhookia dubia, Utricularia lateriflora,* and *Selaginella Preissiana.* These plants, however, take no part in peat building. They flourish on the very wet bare portions. The pioneer in building up of peat is *Chorizandra enodis,* which fixes and raises the surface. After a time *Chorizandra* becomes mixed with and finally suppressed by *Cladium junceum.* As soon as a more solid surface is formed other plants appear. Among the first are *Hypolaena lateriflora, H. fastigiata, Leptocarpus,* and *Lepidobolus,* with *Lycopodium laterale* and *Sprengelia incarnata. Lycopodium carolinianum* flourishes best when the peat building is rather slow. As the surface becomes raised *Sprengelia* becomes more and more abundant and approaches dominance in association with *Xyris operculata* and *Epacris,* while the Restionaceae become more or less suppressed. These plants in turn gradually give way to *Leptospermum scoparium,* which is associated with *Lepidosperma exaltatum.*

By the drainage channels the succession is somewhat different. *Patersonia* and *Lepidosperma* spp. commence except in very large channels where *Phragmites* is present. These are followed by *Cladium tetragonum* with tufts of *Gahnia psittacorum,* which are in turn ousted by *Leptospermum scoparium,* with *Acacia retinodes* and *Viminaria denudata.* The successions outlined here are the general sequence, but frequent local variations and modifications occur which cannot be detailed here.

Round the margins of the swamps the peat is thinner, it becomes much drier in summer, and is more mixed with mineral matter. The vegetation, too, is considerably changed as compared with the central parts; *Sprengelia* is much less abundant, as also are the pteridophytes. *Hypolaena fastigiata* becomes very prominent, far more so than *H. lateriflora,* and is associated with *Epacris, Cladium glomeratum,* and, locally, large quantities of *Leptocarpus Brownii.*

Peaty-silt Swamps at Gully Heads.

The swamps that occur at or near the heads of some of the gullies in the hills are in some ways intermediate between the two types described above. The soil is a black peat which, however, contains a considerable mixture of rather fine inorganic silt. This peat is quite structreless and without the fibrous character of the pure peats. The soil here is less wet than that of the pure peats—even in Winter the surface is not submerged; on the other hand, in Summer, more water is retained than in the silt swamp soils.

Trees are absent here from the swamp proper, though *E. rubida,* and occasionally *E. viminalis,* occur round the margins. The main vegetation is composed of *Leptospermum scoparium* with *Acacia retinodes* along channels. *Sprengelia incarnata* occurs abundantly, for the most part between the bushes of *Leptospermum.* The undergrowth consists of a variety of herbs, generally of small size, amongst which *Hypolaena lateriflora, Cladium tetragonum, Schoenus apogon, Centrolepis strigosa, Drosera binata,* and *Halorrhagis parviflora* are abundant. Other noticeable plants are *Utricularia dichotoma* and *Microtis parvifolia.* Local large tufts of *Gahnia psittacorum* are present, and *Cladium glomeratum* is frequent. In the drier parts, around and beneath the bushes, *Lindsaya linearis* is very abundant. *Gleichenia circinata* forms great masses along the banks of drainage channels, when it locally excludes all other plants; *Blechnum discolor* also occurs along channels.

Under thickets of *Acacia retinodes,* where the shade is rather dense, the ground plants are rather scattered; the most abundant are *Drosera binata,*

Villarsia reniformis, Gratiola peruviana, and *Scirpus inundatus*. Along the outflow stream channel *Phragmites communis* is abundant, along with *Gahnia trifida, Leptospermum scoparium,* and, locally, *Viminaria denudata.*

The following lists of the species observed in examples of swamps of the three types described above will show the relationships of these and also bring out some of the differences between them.

Analysis of Swamp Floras.

In the lists below the occurrence only of the plants is recorded. No attempt has been made to give relative frequencies. This is done for two reasons: first, the lists are not of simple communities, but cover a number of stages of the development, and so frequencies, if given, could not give a true picture of the vegetation; secondly, the lists are certainly far from complete.

These lists contain those plants actually seen by us in the three localities specified. They are not composite lists made up from a number of different places:—

List of Plants of Swamps.

	A. Silt Soil. Mylor.	B. Silt with Peat. Smith's Swamp, near Mylor.	C. Peat Soil. Square Water-hole.
Lindsaya linearis, Sw.		+	+
Adiantum aethiopicum, L.	+		
Blechnum discolor, Keys.		+	
B. capense, Schlecht.		+	
Gleichenia circinata, Sw.		+	
Schizaea fistulosa, Labill.			+
Lycopodium carolinianum, L.			+
L. laterale, R. Br.			+
Selaginella Preissiana, Spreng.			+
Themeda triandra, Forsk.	+		
Calamagrostis quadriseta, Spreng.	+		
Danthonia penicillata, F. v. M.	+		
Briza minor, L.	+		
B. maxima, L.	+		
Poa caespitosa, Forst.	+	+	
Cyperus tenellus, L. f.	+	+	
C. rotundus, L.		+	
Schoenus axillaris, Poir.		+	
S. apogon, R. & S.	+	+	
S. brevifolius, R. Br.			+
Scirpus setaceus, L.		+	+
S. stellatus, C. B. C.		+	
S. inundatus, Poir.		+	
Chorizandra enodis, Nees.			+
Cladium junceum, R. Br.	+	+	+
C. glomeratum, R. Br.	+	+	+
C. tetragonum, J. M. Bl.		+	+
Gahnia trifida, Labill.		+	
G. psittacorum, Labill.		+	+
Lepidosperma exaltatum, R. Br.		+	+
L. semiteres, F. v. M.	+		
Carex appressa, R. Br.		+	
C. Gaudichaudiana, Kunth.	+		
Leptocarpus tenax, R. Br.			+
L. Brownii, Hook. f.			+
Hypolaena lateriflora, Benth.		+	+
H. fastigiata, R. Br.			+
Lepidobolus drapetocoleus, F. v. M.			+
Brizula gracilis, Hieron.		+	
Centrolepis aristata, R. & S.	+		+
C. fascicularis, Labill.		+	
C. strigosa, R. & S.	+	+	+
Xyris operculata, Labill.			+

	A. Silt Soil. Mylor.	B. Silt with Peat. Smith's Swamp, near Mylor.	C. Peat Soil. Square Water-hole.
Juncus capitatus, Weig.	+		
J. bufonius, L.	+		
J. planifolius, R. Br.	+	+	
J. holoschoenus, R. Br.	+	+	
J. pallidus, R. Br.	+		
J. pauciflorus, R. Br.	+		
J. polyanthemus, Buch.	+		
Burchardia umbellata, R. Br.	+	+	
Chamaescilla corymbosa, F. v. M.	+	+	+
Bartlingia sessiliflora, F. v. M.		+	
Hypoxis glabella, R. Br.	+		
Patersonia longiscapa, Sweet.	+	+	+
P. glauca, R. Br.			+
Microtis porrifolia, Spreng.		+	
M. atrata, Lindl.	+		+
Caladenia carnea, R. Br.		+	
Diuris palustris, Lindl.		+	
Casuarina distyla, Vent.			+
Hakea rostrata, F. v. M.	+		
H. ulicina, R. Br.	+		
Banksia marginata, Cav.	+		
Stellaria palustris, Retz.		+	
Ranunculus lappaceus, Sm.	+	+	
Cassytha glabella, R. Br.	+		
Drosera pygmaea, DC.	+		
D. binata, Labill.		+	+
D. peltata, Sm.	+	+	+
D. auriculata, Backh.		+	
D. Whittakeri, Planch.	+		
Acacia verticillata, Willd.	+	+	+
A. retinodes, Schlecht.		+	+
Sphaerolobium vimineum, Sm.		+	+
Viminaria denudata, Sm.	+	+	+
Dillwynia hispida, Lindl.	+		
Bossiaea prostrata, R. Br.	+		
Kennedya prostrata, R. Br.	+		
Oxalis corniculata, L.		+	
Hibbertia stricta, R. Br.	+		
H. acicularis, F. v. M.		+	
Hypericum japonicum, Thunb.		+	
Viola hederacea, Labill.		+	
Pimelea glauca, R. Br.	+		
Lythrum hyssopifolium, L.	+	+	
Eucalyptus rubida, Deane & Maid.	+		
E. rostrata, Schlecht.	+	+	
Leptospermum scoparium, Forst.	+	+	+
L. lanigerum, Sm.			+
Melaleuca decussata, R. Br.		+	+
Halorrhagis teucrioides, A. Gray	+		
H. tetragyna, R. Br.	+		
H. micrantha, R. Br.		+	
Hydrocotyle callicarpa, Bunge.			+
Xanthosia pusilla, Bunge.		+	+
Epacris impressa, Labill.	+	+	+
Sprengelia incarnata, Sm.		+	+
Villarsia reniformis, R. Br.			
Gratiola peruviana, L.		+	
Euphrasia Brownii, F. v. M.	+	+	+
Utricularia lateriflora, R. Br.			+
U. dichotoma, Labill.		+	
Stylidium despectum, R. Br.	+		
Levenhookia dubia, Sond.			+
Leptorrhynchus squamatus, Less.	+	+	
Erechthites hispidula, DC.	+		
E. arguta, DC.		+	

It seems advisable to add a few notes on the above lists. The total number of species listed is 108, of which 53 occur in A, 59 in B, and 42 in C. Of the total species only 10, 9·2 per cent., are common to all three; this number is 18·8 per cent. of the flora of A, 16·9 per cent. of B, and 23·8 per cent. of C; 10 species occur in A and B but not in C; 13 species, 12 per cent. of the total, occur in B and C but not in A—this is 22 per cent. of B and 30·9 per cent. of C. These may be regarded as being a definitely peat-loving element of the flora. Only two species *(Centrolepis aristata* and *Microtis atrata)* occur in A and C but not in B, and it is probable that a more prolonged search would lead to the discovery of these in the other type.

A marked feature of the lists is the large number of species that are recorded from one only of the types; this number is more than half of total flora, 73 species, or 67·5 per cent. In A there are 30 peculiar species representing 56·6 per cent. of its flora, or 28·7 per cent. of the whole; while B has 26, 44 per cent. of its flora, or 24 per cent. of the whole. In C there are 17 species, the corresponding percentages being 56·6 per cent. and 15·7 per cent.

If allowance is made for these localized species the numerical relationships of the types become more obvious. Of the 35 species that occur in more than one type, 28·4 per cent. are common to all, 28·4 per cent. to A and B, and 37·4 per cent. to B and C. Only 5·7 per cent. occur in A and C but not in B. These figures clearly indicate the intermediate character of B.

The number of species in common to all three types is small, but it contains those plants, *e.g., Cladium junceum, Patersonia longiscapa, Acacia verticillata, Viminaria denudata,* and *Leptospermum scoparium,* that give character to the more highly developed stages of the vegetation. Further, the lists are based on three particular examples only; there is no doubt that were a more extended area listed it would show a larger number of common species.

It is, perhaps, surprising that the type with the most marked habitat, C, the peat soil, should show the smallest flora and, still more, the smallest percentage of peculiar species. This is to a large extent due to the complete absence of invaders from dry land communities in this case. In the other lists some such plants are included, since they occur as normal constituents of the florulas.

8. Modifications.

Before consideration is given to the questions of relationships and successions among the communities, something must be said about the results of man's operations on the vegetation both as it exists and on regeneration. Under this general heading are included all such activities as felling, drainage, pasturage, and introduction of grazing animals and so on. Again, such things as fires, which have been considered already to some extent, would be included here. Other features to be taken into account are ringbarking of trees, which has in parts been carried on on a wholesale scale, and also the deliberate planting of trees. In any portion of the whole area here considered into which man has carried his activities in whatever form, a very noticeable and remarkable feature is the incoming of alien plants. Some of these, as has been noted, have spread beyond the direct range of modification and have come to occupy a definite place in the plant communities; others are more restricted. The introduction of grazing animals has had an especially marked effect on the vegetation, and when this is combined with fencing in of areas so that the action is more concentrated, in many cases the native flora has become almost eliminated, or even totally disappeared. The rapidity and completeness of this change from the indigenous flora to a community of alien species is very remarkable. In any consideration of these changes, and of the apparent ease with which the alien

invader overcomes the native flora, two things must be borne in mind: first, that the Australian flora has been geographically isolated from the rest of the world for a very long period of time; and secondly, that, till the arrival of the white man, there were no gregarious, close-grazing, herbivorous animals at all. The native plants consequently had not been in any way subjected to the selective operations of competition with newly arriving plants, or, more importantly, to close-grazing, even on the small scale carried out by a quite wild fauna. Consequently the introduction of cattle, sheep, horses, and rabbits, to mention only the most common, has had a much more profound effect than occurs in a country where such animals live naturally.

The long-continued geographical isolation, and the absence of any native browsing animals in a continent with a rather severe type of climate, appear to be important factors underlying this instability of the vegetation in the face of interference by man.

Where actual destruction of the native flora has occurred, its regeneration is handicapped to a greater or less extent by the small amount of seed that is produced. This lack of full seed-production is quite a notable feature of a large number of the plants. The aliens, on the other hand, are in nearly all cases very free-seeding plants. These alien plants are a very varied assemblage, both in their country of origin (Black, 1909) and in their growth forms; there are shrubs, undershrubs, and herbs, both annual and perennial. Some of them have been deliberate introductions that have spread beyond control, but the majority are of the nature of weeds; some are decidedly obnoxious weeds, that are disadvantageous from the practical standpoint. However, it is not proposed here to enter into any detailed account of these alien plants.

As might be expected, the more open "savannah" forests of blue gum, peppermint, or red gum have provided localities more readily captured by these aliens than the denser covering present in the stringybark forests. This is, however, to a considerable extent due to the soil types and to the relative ease of access. The stringybark forest occupies the least responsive type of soil and is also developed here on the plateau region which is the least accessible. Gullies, moist flats, and any moist situation, even in the stringybark forests, have been especially captured by aliens, and few exist in the more accessible parts of the ranges that have not been reached by some one or more of these invaders. Among the most widespread of these gully and moisture plants that have come in are *Rosa rubiginosa, Rubus fruticosus, R. diversifolius, Ulex europaeus, Cytisus canariensis, C. scoparius, Verbena bonnarensis, Rumex crispus, Verbascum virgatum,* and others.

Effect of Clearing Fires, etc., on Stringybark Forest.

The stringybark forests, which occupy the least valuable soils (in many cases soils which are wholly unproductive for agricultural processes), have suffered less direct interference than the other forest types. Felling for timber purposes has been carried on, and, on most of these ranges, really large trees are completely absent. *E. obliqua* sprouts readily from the stool and coppice woods are often formed when each stump produces many stems. When such coppice regeneration takes place and is not otherwise interfered with a very dense cover is produced that causes a suppression of many plants of the undergrowth. This dense canopy is, however, temporary. After a time only a limited number of the shoots survive and the forest assumes a condition very similar to the untouched one. On rocky soils before this dense cover is produced, *Themeda triandra* and *Lepidosperma semiteres,* with sometimes *Stipa scabra,* may become exceedingly abundant for a time after felling. The usual practice after

felling is to get rid of the *débris* by burning, which may, and often does, produce marked effects on the regeneration. The stools are often killed, so that coppice shoots do not form, and any regeneration has to come from seeds. These germinate very readily, and if the fire is not repeated, the forest commences to regenerate quite rapidly. The undergrowth in general passes through the phases described earlier, though the absence of cover and the disturbance that occurs to the soil and plants during the felling operations often allow entrance to a number of aliens, especially where cultivated ground or roadways are adjacent. The most important aliens are *Cytisus canariensis,* and in sheltered places *Ulex europaeus.* These may spread with such rapidity that they capture the habitat completely, prevent regeneration of native plants, and drive out those existing. These plants, especially *Cytisus,* may spread in this way after a fire, even when felling has not taken place. *Rubus fruticosus* and *Rosa rubiginosa* also spread freely, but not to the exclusion of all others, as do *Cytisus* and *Ulex.* An exception is provided in the case of *Rubus fruticosus* (pl. xx., fig. 1), when growing beside a watercourse or swampy patch in the stringybark area. Besides the shrubby plants a number of smaller plants invade after interference and take a place among the native plants; examples of these are *Rumex acetosella, Cirsium lanceolatum, Plantago lanceolata,* and several annual grasses.

Grazing has not been carried out to a large extent in the stringybark forests owing to the lack of nutritive plants in their undergrowth. However, some of the forests at the lower levels have been grazed and changes produced thereby. Besides the prevention of tree regeneration and opening up of the ground cover by elimination of shrubs, partly by browsing and partly by trampling, a feature worthy of mention is the rapid and complete disappearance of *Themeda triandra.* This, the so-called kangaroo grass, is quite a useful fodder plant, but has very slight powers of regeneration after being eaten down. It is quite a common sight to find this grass tall and luxuriant on the outside of a grazing fence, while inside not a trace of it can be found.

Stringybark forests, in the absence of depasturing, rather rapidly recapture cleared ground when this is abandoned. The forests developing on such cleared areas soon assume the features of the surrounding untouched parts with certain exceptions; *Xanthorrhoea semiplana* when once eliminated seems almost unable to return, or, at any rate, does so at an exceedingly slow rate. One example may be quoted which occurred on the summit of a quartzite ridge. Here a portion of the forest had been cleared and used as an orchard. At the time of our visit this had been abandoned for twenty-four years. The once cultivated area was entirely covered with forest and was only distinguished from the surrounding untouched parts by the small size of the trees and a complete absence of *Xanthorrhoea. Epacris impressa* and *Pultenaea daphnoides* were present in rather less quantity. Very few aliens had survived, and none in any quantity.

Not inconsiderable portions of ground that was at one time occupied by stringybark forests have been cleared and planted with pines. *Pinus insignis,* and to a less extent *P. maritima,* have been used. Both these plants, and especially the latter, are spreading by seed to some extent into the forests. But in the absence of fires they do not seem able to defeat the natural vegetation. In some cases after a fire *P. maritima* is coming up in such quantity that with the amount of shade it casts it is ousting the natural forest. This, however, is rather local.

Changes in the Open Forest Types.

A different condition of things is seen in the case of the forests of blue gum and peppermint. Very few of these forests are without obvious traces of interference. The open canopy and the grass-like flora have from the time of

the earliest settlers been indicative of pasture land and have been used as such to a greater or less extent. This has caused in many cases an almost total removal of the native flora and its replacement by aliens which are either annuals or plants of tufted or rosette habit that withstand pasturage. Among the most common and widespread are *Briza maxima, B. minor, Aira caryophyllea, Dactylis glomerata, Plantago lanceolata, Erythraea centaurium, Anagallis arvensis, A. caerulea, Inula graveolens, Hypochoeris radicata, H. glabra,* with also *Medicago denticulata, Trifolium angustifolium,* and *T. tomentosum; Verbascum virgatum* has become almost dominant on some valley sides. Another plant that has become locally dominant and which is spreading rather rapidly is *Hypericum perforatum.* Where this plant is abundant it drives out all others. It resists fires and, as it is not touched by animals, if strong repressive measures are not taken it has all the appearance of becoming a very noxious weed and one which will cause a rapid deterioration of land.

Besides the herbaceous plants mentioned above some introduced shrubs are present in these forests. On dry rather rocky slopes *Gomphocarpus arborescens* and *Olea europaea* are abundant. *Lavendula Stoechas,* a comparatively recent incomer, is spreading very fast and has formed an almost closed cover in some parts. *Crataegus oxycantha* occurs in sheltered spots and, locally, *Lycium campanulaceum,* on the lowest slopes. Several others are occasional.

On the rolling "savannah" country on the east side of the hills much of the forest has been destroyed by ringbarking (pl. xvi., fig. 2, and pl. xix., fig. 1). This has occurred elsewhere, though not on a large scale, in these ranges. The process is carried on in order to obtain pasture land rapidly and cheaply. The killed trees are left standing. Ringbarking, followed by the introduction of stock in any quantity, completely prevents regeneration of the forest from seedlings and causes a considerable alteration in the ground flora owing to the introduction and spread of grasses and rosette plants. A quite short period of time with this treatment is sufficient to produce an apparently stable grassland community with no sign of trees. That this community is maintained by the grazing factor is demonstrable, however, by the fact that wherever the animals are excluded young trees make their appearance. For example, along railway lines and other enclosures young trees come up in numbers, though elsewhere there is no sign of them. In a few cases areas have been left untouched for some years and a vigorous forest has reappeared. Over most of the district studied, however, the forest is being destroyed faster than it can regenerate.

The peppermint forests, more than any other, have become altered by interference. Several factors have combined for this. The forest occupied the lowest and most accessible parts, consequently it was the first to be attacked. The soil holding water in winter is readily colonized by grass, and the trees, being small and of low timber value, have always been regarded as quite useless. The results have been that this type of forest has been enormously reduced in area, whilst, at the present day, only in the more remote and steeper portions has it retained anything approaching its natural flora. Much of the forest now has a flora composed wholly of alien plants which are largely grasses or grass-like. The commonest grasses are *Dactylis glomerata, Bromus maximus, B. mollis, B. unioloides, Festuca bromoides, Cynodon dactylon, Briza maxima, B. minor, Aira caryophyllea,* with many others. *Themeda triandra* appears only in places protected from grazing. Along with the grasses occur many other plants, of which only a few of the most abundant can be mentioned: *Inula graveolens, Cryptostemma calendulacea, Calendula arvensis, Hypochoeris radicata, H. glabra, Plantago lanceolata, Erythraea centaurium, Echium plantagineum, Bartsia latifolia, Trifolium angustifolium, Medicago denticulata, Oxalis cernua, Erodium*

moschatum, E. botrys, Romulea rosea, R. columnae, Sparaxis tricolor, and very many others. In a few portions where the forests have been left untouched for some time, *Acacia armata* has appeared in masses forming rather dense thickets.

The red gum forests have suffered in a similar way. Much of the land originally occupied has been used for cultivation and the forest destroyed altogether. But apart from this, the moist level situations have been chosen for pastures. Many of the aliens of the drier forests have appeared along with some that are much more abundant here, *e.g., Taraxacum officinale, Trifolium repens, Moenchia erecta, Juncus capitatus, J. bufonius.* Few of these woods are free of *Rosa rubiginosa,* which spreads very rapidly. *Rubus fruticosus, Crataegus oxyacantha,* and *Cytisus canariensis* have also locally spread in great quantities. Along the creeks themselves *Zantedeschia aethiopica, Watsonia Meriana,* and *Alisma plantago* have become established locally, along with others. *Rumex crispus* and *Foeniculum vulgare* are common on flats.

The red gum is especially active in the recapture of its habitats, however, where the disturbing factors are removed. Then thick groves of seedling trees appear, and in their early years grow with rapidity whether in a once pastured forest, a cleared area, or even on derelict arable land. Some interesting and instructive examples of this regeneration occur on these hills. One case may be noted here. The land 30-40 years ago was cultivated for wheat, but has since been abandoned, and at present is occupied by a dense forest of young red gums. The surface still bears a distinct impress of the furrow lines (pl. xx., fig. 2). None of the other forests are able to regenerate so quickly and completely. In the case of blue gum the recolonization is rather slow, and on the slopes the young trees often appear in groups not infrequently associated with *Casuarina stricta.* Indeed, where blue gum and red gum habitats adjoin, the latter on recolonization appears to spread out and occupy part of the habitat of the former. Part, at any rate, of the spread of *E. rostrata* beyond the valley limits in the savannah country seems attributable to this much more vigorous seed regeneration. Exactly the same capture of marginal habitats occurs to some extent with stringybark, which can regenerate to a certain degree at the expense of the blue gum. These cases of capture of habitat require careful and detailed study and cannot be further considered at present.

When a habitat has become occupied by large numbers of alien shrubs, *e.g., Cytisus canariensis, Ulex europaeus, Rubus fruticosus,* etc., the regeneration of the light-demanding Eucalypts may be prevented altogether.

9. Relationships and Development.

The area of the Mount Lofty Ranges that has been studied covers regions of annual precipitation varying between 20 inches to over 40 inches. Eighty per cent. or more of this precipitation falls within the winter months. Thus the area includes several distinct climates, each of which, as we shall see, has its own characteristic development of vegetation.

As a whole, the area is at present a region of geological stability; the agents of erosion and change are not active, and as a result the habitats are more or less permanent and not changing. This stability is clearly indicated in the small amount of erosion that has taken place since the earth movements that raised up the very ancient rocks that make up these hills. Even in those cases when rivers have cut right across the main watershed ridge the valleys formed are deep and approaching their base level, and, with an almost complete absence of lateral drainage channels, are not enlarging to any extent. The most striking evidence of the geological stability, as pointed out by Howchin (1910), is afforded by the existence of the rather extensive glacial deposits of presumably Permocarboni-

ferous age. These deposits are, in part at least, not even consolidated as rock and are yet still extensive.

This habitat stability, combined with the geographic isolation of the continent, which has prevented plant migrations and invasions, has resulted in nearly all the vegetation having continued its development to the climax permitted by the climate and the local habitat conditions.

Stringybark Formation.

The most clearly defined vegetation unit is that of the stringybark forest which covers the quartzitic backbone of the ranges. This forms a homogenous group of communities with a distinct habitat and developed in a definite climatic zone of 30 inches or more of rainfall, the bulk falling in the Winter. The chief stable community here is evidently the *E. obliqua* forest. This is widespread and has all the features of a climax community. Is is relatively complex, exceedingly stable, and, if destroyed, has very marked powers of regeneration. The forest must be regarded as an association (Clements, p. 128) made up of two consociations, dominated by *E. obliqua* and *E. capitellata*, respectively. These two forests certainly appear to be the result of slight changes of habitat within the climatic zone. There is no evidence that the one can develop into the other. On the other hand, the positions of *E. fasciculosa* woods and *Casuarina* scrub are quite different. Both appear as developmental stages in the sere that culminates in the *E. obliqua-E. capitellata* forest climax. These stages are, however, often rendered apparently stable and fixed owing to local edaphic or physiographic conditions. *E. fasciculosa* occurs, as noted above, in situations which are liable to drought or when the soil is very shallow or rocky. Wherever the conditions are less extreme the climax forest appears. Good examples of this are very frequent; on narrow ridges the crest is often covered by *E. fasciculosa*, while the slopes have *E. obliqua*. Again, in Morialta Gorge, the main slopes are covered by *E. fasciculosa* woods, but where a southerly exposure occurs there *E. obliqua* appears. *E. fasciculosa* represents in these cases the furthest stage that the development can reach under the local conditions, but, wherever these are improved, the final stage can be reached. As was pointed out earlier the flora, as a whole, in a pink gum forest is that of the climax stringybark, though without those plants that demand more moisture, shelter, humus, etc. As further evidence of the fact that pink gum is a developmental stage, it may be again noted that this tree is frequently present in large quantity where regeneration after destruction is taking place.

Forests of pink gum were described as occupying the rocky outcrops from which the loose glacial deposits have been washed off. Here the exposure of the underlying rock is relatively recent (Howchin, 1910), and the forests existing may perhaps represent the furthest stage that the development has yet reached.

The community of *Casuarina stricta* and *Xanthorrhoea quadrangulata*, which occurs on the steep, very rocky slopes, is a still earlier stage existing when development is suspended until the soil is produced. Here, indeed, the further stages are indicated wherever conditions allow, *e.g.*, on talus slopes, in gullies, etc., where *E. fasciculosa*, or even *E. obliqua*, are found. Again, in many forests on steep valley sides individuals of this community often occur scattered through a forest, and may be regarded as relics of an earlier phase. It is not to be assumed, of course, that all these communities represent stages in the primary sere leading to the climax forest in the sense that all the forest has at one time passed through them. Rather is it considered that under the special edaphic conditions the development reaches these stages and, should the conditions become favourably modified, then the climax forest will come in.

Exactly the same arguments apply to the scrub of *Casuarina distyla*. Here again, as was pointed out earlier, further development is indicated in the presence of groups or individuals of *E. fasciculosa* or *E. capitellata*.

The position of the *E. cosmophylla* scrub has already been considered to some extent. It appears to represent a stable end point determined by the edaphic factors. Looked at from the standpoint of general development this community, being a scrub forest, is less advanced than the high forest of *E. obliqua* which occurs in exactly the same climate. It is, perhaps, most logical to regard the *E. cosmophylla* scrub as a subclimax prevented from the normal development to high forest by edaphic conditions. The dwarf scrub of *E. capitellata* on the glacial deposits occupies a completely analagous position, and is again an edaphic subclimax. The relationship is clearer here, perhaps, because the climax forest appears in gullies and by streams in this region.

The relations of the forests of *E. elaeophora* to those of *E. obliqua* and *E. capitellata* have been discussed earlier. There seems little doubt that in this case we are dealing with a climax. It is one closely allied to the *E. obliqua-E. capitellata* climax, and one with very similar development. As suggested earlier, it appears to be differentiated by climatic and edaphic factors. Taking all the evidence into consideration, we can hardly escape the conclusion that all these communities belong to one formation—the stringybark formation. The climax of this is an association of *E. obliqua* and *E. capitellata* on the one hand and a consociation of *E. elaephora* on the other. All the other communities are of subsidiary grade, and are either developmental phases or subclimaxes due to special edaphic conditions. In the gully flora of the Mount Lofty forests there is an indication of a type of stringybark forest developed in a moister climate.

Savannah Woodland Formation—a. Blue Gum Forest.

When attention is turned to the blue gum forests a very marked contrast is at once apparent. They differ not only in habitat, but still more in the facies, structure, and flora. As mentioned, the transition is often abrupt, but further, these forests occupy a different though contiguous climatic zone. While the stringybark forest does not occur where the rainfall is much less than 30 inches, the blue gums flourish between 25-35 inches, and even occur where the rainfall is as low as 20 inches. Within this zone and on the suitable soils *E. leucoxylon* forms a climax forest. It is almost universally present here; it is a stable community, though reproduction is often slow. Developmental stages occur, though they are less apparent as the characteristic tree of the climax appears at an early stage. *E. viminalis,* which is so frequently an associate of *E. leucoxylon*, occurs where the conditions are rather moister, and more especially where the extremes of atmospheric dryness are less. It occurs especially in gullies. The pure forests of *E. viminalis* which occur locally, as described above, represent a consociation of moist conditions.

The communities of varying size of *Casuarina stricta* which occur on rocky outcrops occupy an interesting position in the developmental story. If one travels from the Mount Lofty Ranges eastwards towards the "Ninety-mile Desert" one crosses zones of progressively decreasing rainfall. The forest is found to become more and more open, and finally to disappear and be replaced by scrub communities, *e.g.*, mallee Eucalypts. The only woodlands that occur are those on rocky places composed of *Casuarina stricta*. Under rainfall conditions where rocky soils alone can support forest these *Casuarina* woods must be regarded as a climax. But when the conditions are more favourable, as in the Mount Lofty Ranges themselves, the development can continue beyond the stage of *Casuarina* woods, which only exists under special edaphic conditions. In the region under study this community must be regarded as an edaphic subclimax.

Now, although the climatic zones, which here produce blue gum forests and stringybark forests, respectively, are so close or even identical, it seems impossible to regard the two as belonging to one formation. The composition, structure, and development of the two climax forests are so totally distinct. Evidence of the essential difference of the two types becomes much more apparent when consideration is taken of the region adjacent to these ranges. On the hills further north and on the Flinders Ranges, which have a lesser rainfall, forests of blue gum or of other species, with the same general structure and flora, are present, but not the stringybark type. To the south and east, however, the latter type becomes the more prevalent. At Mount Gambier, for example, with a rainfall of 35-40 inches, forests of *E. obliqua* occur at sea level. Again, in the mountains of Victoria where, not only is the rainfall higher but less confined to Winter months, the forests approach much more closely to the stringybark type; *E. obliqua* forests are present. On the drier northern exposures of the Dandenong Range in Victoria, for instance, forests very much like those described do occur; elsewhere in the same district the type is more allied to the "gully flora" in the Mount Lofty area. The savannah type of forest is not present on these Victorian mountains.

At Mount Lofty it would thus appear that we are dealing with the ecotone between two forest types. The stringybarks are approaching their limit owing to dryness, while the more continental blue gum forests are nearing the moister end of their range. At the junction region edaphic factors become more apparent in differentiating the two which are broadly separated climatically. The *E. elaeophora* forest which, as has been shown, has some features in common with the blue gum forest, represents an extreme climatic variant of the stringybark formation.

Savannah Woodland Formation—b. Peppermint Forest.

The peppermint forests are allied to those of blue gum both in structure and in flora. These forests occur in regions of rather less rainfall, and on the whole with a soil difference. This soil difference is, however, rather slight, and in places one or other type of forests occurs on intermediate soils. On the foothills above the Adelaide plains *E. odorata* frequently clothes northern exposures, and *E. leucoxylon* southern ones, on the same soils and at the same altitude. As is the case with the forests discussed above, so here, the two are climatically determined though their zones overlap. In the neighbourhood of Kapunda, for example, and on the hills to the north of "the Kapunda gap," *E. leucoxylon* forests are confined to the main ranges, which have a rainfall of 22 inches and upwards, while on the drier foothills *E. odorata* occurs. *E. odorata* also extends on to the plains, and as a mallee may reach zones with a rainfall as low as 12 inches. While one must thus regard both the *E. odorata* forests and those of *E. leucoxylon* as representing the climax types of distinct but similar climates, yet the resemblances and similarities in structure, flora, and behaviour are so marked that it does not seem advisable to treat them as belonging to separate formations. They belong to the same climatic type, with rather low rainfall, mainly occurring in Winter, but to different zones of it. At present we consider them as representing two subformations of what for the moment may be termed the savannah woodland formation.

Red Gum Forest.

The red gum forests are quite distinct. They form a unit determined by the edaphic factor of abundant ground water, at any rate for a season. It is essentially a river and creek-side formation, and as such occurs over a very wide

range and in several different climates. This forest is the most widespread of any type in Australia, occurring, as it does, wherever the necessary habitat conditions are present and the rainfall is 8 inches or more. In regions of lesser rainfall *E. microtheca* takes the place of *E. rostrata*. To the east of the Dividing Range in New South Wales the forests in these situations are composed of the closely allied *E. tereticornis*.

In the region under consideration the red gum forests are only small outliers. In structure they are much more closely allied to the savannah forest than to the stringybark. This alliance is further evidenced in the broad zone of mixed forest that often occurs between red gum and blue gum.

Swamps.

The swamps must be treated as a separate group at present with a community of *Leptospermum scoparium* representing the highest phase of their development. In the entire absence at present of any evidence for or against the stability of this community, it is unwise to state what rank this is or what its relations to the climatic climaxes may be.

VII. SUMMARY.

Three formations are recognized on the Mount Lofty Ranges, namely:—

I. STRINGYBARK FORMATION with a Winter rainfall of 30 inches or more. This is made up of an association of *E. obliqua* and *E. capitellata*, the former often, and the latter occasionally, as a pure consociation. There is also consociation of *E. elaeophora*. In addition, there are edaphic subclimaxes of *E. cosmophylla* scrub and of dwarf *E. capitellata* scrub. Various scrub communities occur.

II. SAVANNAH WOODLAND FORMATION, with a rainfall of 15-35 inches, with two subformations:—*(a)* Blue gum subformation; *(b)* peppermint subformation, representing the wetter and drier zones.

III. RED GUM FORMATION, a river-side forest on deep soils holding water.

Lastly, there are swamps whose exact relations are not determined.

Turning to the general relationships of these formations, rather varied opinions have been expressed as to the type to which the forests belong. They have been described both as sclerophyll forests and as savannah forests (Diels, Taylor, Osborn, 1914). On this point the dominant tree alone gives very little indication. The genus *Eucalyptus*, with its very numerous species, has a xerophytic leaf that approaches often very closely the so-called typical sclerophyll, but this type of leaf, in Australia, is possessed by trees occurring in such a variety of climate and habitat that it has no indicator value. It occurs here where the climate is essentially the sclerophyll type, also in the much more arid regions of the mallee country on the plains by the River Murray. Again, in the rain forests of Victoria, and even of Tasmania, with a wholly different climate, the same leaf type occurs on the trees (Rodway). Indeed, the leaf form of *Eucalyptus* cannot be regarded as being directly correlated with its present habitat; it seems rather a hereditary ancestral feature which is only capable of very slight modification under existing conditions. These remarks apply not only to *Eucalyptus*, but to other genera as well, notably to the phyllode-bearing species of *Acacia*.

Consequently to arrive at a conclusion as to the type to which a community belongs it is necessary to take the whole flora into account. Here, as mentioned earlier, one is struck by the great variety of leaf form and growth habit in the stringybark forest. While the whole flora is xerophytic it covers a wide range of detail. The stringybark forests, however, agree in most features with other regions of sclerophyll woodland. The much greater forest development is

striking as compared, for example, with the Cape Peninsula or Corsica. As compared with the Mediterranean generally the flora here is distinctly more xerophytic and has many fewer flat-leaved species. It also shows much less of the transitions to a "laurel" type in gullies, etc.

While the stringybark forest can be treated as a true sclerophyllous forest, the savannah forest belongs to a quite distinct type. Both from their distribution and structure these forests belong to a drier type and more continental climate. The sclerophyll is essentially an oceanic or suboceanic type, and here we have it in its most continental form. The savannah forest, which becomes dried up and dormant to a very large extent in Summer, is a stage further from the oceanic types. It is interesting that the forests of *E. elaeophora,* standing as they do at the climatic limit of the stringybark (sclerophyll) formation, do show certain features of approach to the savannah forest. This is especially the case in those in which *Lepidosperma* spp. becomes more or less dominant on the ground. The savannah forests here show most relation perhaps to some of the woodlands of Argentina (Schimper, p. 457).

VIII. APPENDIX A. LIST OF SPECIES AND STATISTICS.

The following list of species contains all those plants, found by us during the course of our investigations, that is between July and December, 1922. No attempt is made to give a complete list of the known flora. No plant is recorded in the list of which we ourselves have not collected a specimen.

The nomenclature adopted is that used in J. M. Black's "Flora of South Australia" so far as issued; otherwise we have followed Bentham's "Flora Australiensis" and Tate's "Handbook." The more recent changes necessary in nomenclature owing to the International Rules have been adopted with reference to the names used by Maiden and Betche in their "Census of New South Wales Plants." The sequence of species is based on Engler's system, which is that adopted by Black and by Maiden and Betche.

The identifications have been checked by reference to specimens in the Tate Herbarium in the University of Adelaide. A number of doubtful or critical plants have, further, been seen, and our identifications checked, by Mr. J. M. Black, to whom we would like to take this opportunity of expressing our very sincere thanks.

In the first column in the list are given the symbols in common use for the life-form class as defined by Raunkiaer. The allocation of some of the species to their class presented a certain amount of difficulty owing to lack of a full knowledge of the behaviour of the plants; the published descriptions in the floras are frequently lacking in exact details in this connection, and a considerable amount of further work is necessary on this subject before a really accurate "Spectrum" can be obtained. The present list with the life-form classification, though it certainly contains inaccuracies, is sufficiently complete for a limited ecological region to allow of a few preliminary generalizations. Though these are all necessarily somewhat tentative, we feel justified in giving them, as so little work of this kind has so far been done in Australia. We hope that this attempt may stimulate others to follow, and to carry the work further and to more exact conclusions than we have been able to reach.

The results obtained by us for this flora, when compared with those we have already published (Adamson and Osborn) for the much more arid district of Ooldea, suggest that this method may be of considerable value in a discrimination of the different climatic zones in a continent like Australia.

1. Biological Spectra.

In the list 362 native plants are enumerated. In the accompanying table the "Biological Spectrum" is given along with the "Normal" and those of some other districts for comparison:—

	Total	MM.	M.	N.	Ch.	H.	G.	T.	HH.	E.	S.
Mount Lofty ..	362	2	8	25	12	24	17	10	1	(1)1·5	—
Normal*	400	6	17	20	9	27	3	13	1	3	1
Madeira (Lowld.)*	213	—	1	14	7	24	—	51	3	—	—
Ooldea†	188	0·5	19	23	14	4	0·5	35	—	(1)4	—
Denmark* ..	1084	1	3	3	3	50	11	18	11	0·1	—
Long Is., U.S.A.‡	719	5	6·5	3	6	33	20	14	11	—	—

*Smith. †Adamson and Osborn. ‡Taylor.

Comparing this spectrum with the normal, the most marked features are the high figures for Geophytes and for the small woody plants, Nanophanerophytes and Chamaephytes; these last together make 37, as compared with 29 in the normal.

The spectrum shows clearly the climatic influences when a comparison is made with other floras. The high percentages of Micro- and Nanophanerophytes and moderate Chamaephytes are indicative of dry warm conditions as contrasted with the high figures for Hemicryptophytes in the cool temperate climates of Denmark and Long Island (Smith, Fuller and Bakke). The possession of a seasonal rainfall is shown by the large numbers of geophytes and not inconsiderable numbers of Hemicryptophytes. The high figure for geophytes is an indicator of the Winter rains, and forms a contrast with the figures for Summer rain regions which have an excess of Hemicryptophytes or of Therophytes.

The relatively low percentage of annuals here further indicates a regular precipitation, as contrasted with the high figures in the floras of regions with irregular rains, as Ooldea or Madeira.

It would be interesting to compare the spectrum of the Mount Lofty area with that of one of the other sclerophyll regions of the world, but none is available at present.

A comparison of the "spectra" of the floras of the two main formations here is of interest and brings out in a striking manner the essential differences between them.

These spectra are made up from the lists; that for stringybark forests includes the lists given for stringybark, box, and the dwarf scrub; the savannah forest list is for blue gum forests and peppermint forests. The following table gives the results:—

	Total	MM.	M.	N.	Ch.	H.	G.	T.	HH.	E.
Stringybark ..	244	1	9	34	13	23	13	4	0·1	(1)1
Savannah ..	229	1	8	14	12	26	23	14	—	(1)1·5
Normal	400	6	17	20	9	27	3	13	1	3

The differences are both striking and important. The stringybark shows a decided excess of Nanophanerophytes and an abnormally small percentage of Therophytes, while the savannah has a rather small number of the former but a large percentage of Geophytes and the normal percentage of Therophytes. The differences in the figures for these groups mark a different type of flora, and add a further reason for the separation of the two formations. The large proportion of Geophytes and Therophytes in the savannah suggest the flora characteristic of a climate with a less regular precipitation than the nanophanerophytic flora of the stringybark forest. This is exactly the conclusion that was reached from a consideration of the geographical and other evidence considered earlier in this account.

(1) These percentages refer to species of *Loranthus*. True epiphytes are not found in these districts.

The spectrum of the savannah forest in many of its features is intermediate between that of the Ooldea flora on the one hand, and that of the stringybark forest on the other. This is additional support for the contention that the savannah forest is a formation of a more Continental type of climate than the stringybark forest. A consideration of its spectrum leaves no doubt at all that this formation is in no way a sclerophyll formation. The stringybark forest, on the other hand, has in its spectrum all the features of that type of vegetation.

2. Tabular List of Species.

In regard to the other portions of the list, the distribution of the species is given under six heads, namely:—Stringybark Forest, which includes *E. cosmophylla* Scrub and the "Maquis" Scrub; Box *(E. elaeophora)* Forest; the Dwarf Scrub of *E. capitellata,* as seen at Mount Compass; Blue Gum Forests, which include the savannah type of woodland, and also white gum and manna gum woodlands; Peppermint Forests; and, finally, Red Gum Forests.

Occurrence only is given, not the relative frequency in each type.

	Life Form.	Stringy-bark.	Box.	Scrub (Mt. Cmps.)	Blue Gum.	Pepper-mint.	Red Gum.
Adiantum aethiopicum, L.	H.	x			x		
Cheilanthes tenuifolia, Sw.	H.	x	x		x	x	x
Pteridium aquilinum, Kuhn.	G.	x	x		x	x	x
Blechnum discolor, Keys.	H.	x					x
B. capense, Schlecht.	H.	x					
Asplenium flabellifolium, Cav.	H.	x					
Gymnogramme leptophylla, Desv.	H.	x			x		
Pleurosorus rutifolius, Féé	H.	x					
Todea barbara, T. Moore	Ch.	x					
Ophioglossum coriacium, A. Cunn.	G.				x		
Phylloglossum Drummondii, Kunze	G.					x	x
Isoetes Drummondii, A. Br.	G.					x	x
Callitris cupressiformis, Vent.	M.				x	x	
Typha angustifolia, L.	HH.	x					x
Triglochin centrocarpa, Hook.	T.				x	x	x
T. procera, R. Br.	HH.						x
Themeda triandra, Forsk.	Ch.	x	x		x	x	x
Neurachne alopecuroides, R. Br.	H.	x	x	x	x	x	
Amphipogon strictus, R. Br.	H.	x		x			
Stipa setacea, R. Br.	H.	x	x		x	x	
S. eremophila, Reader	H.				x	x	
S. pubescens, R. Br.	H.	x	x		x	x	x
S. semibarbata, R. Br.	H.				x	x	
S. scabra, Lindl.	H.				x		
Sporobolus indicus, R. Br.	H.	x			x	x	
Calamagrostis quadriseta, Spreng.	H.					x	x
Dichelachne crinita, Hook. f.	H.	x					
D. sciurea, Hook. f.	H.	x	x		x		
Danthonia carphoides, F. v. M.	H.				x	x	
D. penicillata, F. v. M.	H.	x	x	x	x	x	x
Phragmites communis, Trin.	HH.						x
Poa caespitosa, Forst.	H.	x	x		x		
Agropyrum scabrum, Beauv.	H.				x		
Cyperus tenellus, L. f.	T.	x			x	x	x
C. vaginatus, R. Br.	H.	x			x		x
C. rotundus, L.	G.					x	
C. Gunnii, Hook. f.	G.				x	x	
Schoenus apogon, R. and S.	H.	x	x	x	x	x	x
Scirpus setaceus, L.	T.					x	x
S. nodosus, Rottb.	G.	x			x		x
Cladium junceum, R. Br.	G.			x		x	x
C. glomeratum, R. Br.	H.			x			
C. acutum, Poir.	H.			x			
Gahnia trifida, Labill.	Ch.	x					x

	Life Form.	Stringy-bark	Box.	Scrub (Mt. Cmps.)	Blue Gum.	Pepper-mint.	Red Gum.
G. lanigera, Benth.	H.			x			
G. psittacorum, Labill.	Ch.	x					
Lepidosperma concavum, R. Br.	Ch.	x					
L. laterale, R. Br.	Ch.	x					
L. viscidum, R. Br.	Ch.	x			x		
L. semiteres, F. v. M.	Ch.	x	x	x	x		x
L. carphoides, F. v. M.	Ch.	x	x		x		
Carex appressa, R. Br.	Ch.	x			x		x
C. tereticaulis, F. v. M.	Ch.	x					x
C. Gaudichaudiana, Kunth.	H.				x	x	x
C. breviculmis, R. Br.	H.				x		
C. Gunniana, Boott.	H.	x					
Leptocarpus tenax, R. Br.	H.			x			
L. Brownii, Hook. f.	H.			x			
Hypolaena lateriflora, Benth.	H.			x			
H. fastigiata, R. Br.	H.	x		x			
Lepidobolus drapetocoleus, F. v. M.	H.			x			
Brizula pumilio, Hieron.	T.				x	x	x
Centrolepis aristata, R. and S.	T.	x	x		x	x	x
C. strigosa, R. and S.	T.	x			x	x	x
Juncus planifolius, R. Br.	H.	x			x		x
J. caespiticus, E. Mey.	H.						x
J. holoschoenus, Buch.	G.	x			x	x	x
J. lamprocarpus, Ehrh.	G.				x	x	x
J. pallidus, R. Br.	H.	x	x	x	x	x	x
J. polyanthemus, Buch.	H.						x
J. pauciflorus, R. Br.	H.	x			x	x	x
Luzula campestris, DC.	H.				x	x	
Dianella laevis, R. Br.	G.	x			x	x	
D. revoluta, R. Br.	G.	x	x	x	x	x	
Burchardia umbellata, R. Br.	G.				x	x	x
Anguillaria dioica, R. Br.	G.	x	x	x	x	x	x
Lomandra dura, Ewart	Ch.	x	x		x	x	
L. longifolia, Labill.	Ch.	x			x		
L. multiflora, J. Britten	Ch.	x					
L. effusa, Ewart	Ch.				x		
L. micrantha, Ewart	Ch.	x	x	x	x		
L. filiformis, J. Britten	Ch.	x					
Thysanotus Patersonii, R. Br.	G.	x			x	x	x
Caesia vittata, R. Br.	G.				x	x	
Chamaescilla corymbosa, F. v. M.	G.	x	x		x	x	x
Tricoryne elatior, R. Br.	G.	x	x		x	x	x
Bulbine bulbosa, Haw.	G.	x			x	x	x
Arthropodium paniculatum, R. Br.	G.	x			x		x
Dichopogon strictus, J. G. Bak.	G.	x	x	x	x	x	x
Bartlingia sessiliflora, F. v. M.	H.					x	x
Xanthorrhoea quadrangulata, F. v. M. ..	M.	x					
X. semiplana, F. v. M.	Ch.	x	x	x	x		
Hypoxis glabella, R. Br.	G.	x			x	x	x
H. pusilla, Hook. f.	G.				x	x	
Patersonia longiscapa, Sweet	H.	x					x
Dipodium punctatum, R. Br.	G.	x					
Thelymitra ixioides, Sw.	G.				x	x	
T. azurea, Rogers	G.			x			
T. grandiflora, Fitzg.	G.	x					
T. aristata, Lindl.	G.				x	x	
Microtis porrifolia, Spreng.	G.			x		x	
Prasophyllum elatum, R. Br.	G.	x					
P. fuscum, R. Br.	G.				x		
P. nigricans, R. Br.	G.				x	x	
Corysanthes fimbriata, R. Br.	G.				x	x	
C. pruinosa, R. Cunn.	G.				x		
Acianthus caudatus, R. Br.	G.	x			x	x	
A. exsertus, R. Br.	G.	x					
Lyperanthus nigricans, R. Br.	G.	x					
Eriochilus autumnalis, R. Br.	G.	x					

	Life Form.	Stringy-bark.	Box.	Scrub (Mt. Cmps.)	Blue Gum.	Pepper-mint.	Red Gum.
Leptoceras fimbriata, Lindl.	G.	x					
Caladenia Patersonii, R. Br.	G.				x	x	
C. dilatata, R. Br.	G.					x	
C. carnea, R. Br.	G.	x	x	x	x	x	x
C. deformis, R. Br.	G.				x	x	x
Glossodia major, R. Br.	G.	x			x		
Diuris pedunculata, R. Br.	G.				x		
D. palustris, Lindl.	G.				x	x	x
D. maculata, Sm.	G.				x		
D. longifolia, R. Br.	G.				x	x	x
D. palachila, Rogers	G.				x	x	
Pterostylis nutans, R. Br.	G.				x		
P. nana, R. Br.	G.	x			x	x	
P. pedunculata, R. Br.	G.				x		
P. cucullata, R. Br.	G.	x			x	x	
P. reflexa, R. Br.	G.				x		
P. vittata, Lindl.	G.				x		
Casuarina stricta, Ait.	M.	x	x		x	x	
C. distyla, Vent.	M.	x	x	x	x		
Parietaria debilis, G. Forst.	T.					x	
Isopogon ceratophyllus, R. Br.	N.	x	x	x	x		
Adenanthos terminalis, R. Br.	N.			x			
Conospermum patens, Schlecht.	N.			x			
Persoonia juniperina, Labill.	N.	x	x	x			
Grevillea lavendulacea, Schlecht.	N.	x	x	x			
Hakea vittata, R. Br.	N.				x		
H. rostrata, F. v. M.	M.	x	x	x	x		
H. rugosa, R. Br.	N.				x	x	
H. ulicina, R. Br.	M.	x	x	x			
Banksia marginata, Cav.	M.	x	x	x	x		x
B. ornata, F. v. M.	N.	x		x			
Exocarpus cupressiformis, Labill.	M.	x	x		x		
Fusanus acuminatus, R. Br.	M.					x	
Choretrum glomeratum, R. Br.	N.			x			
Loranthus exocarpi, Behr.	E.	x			x	x	
L. Miquellii, Lehm.	E.	x			x	x	x
Trichinium erubescens, Moq.	T.				x	x	
T. alopecuroideum, Lindl.	T.					x	
Stellaria palustris, Retz.	H.	x					x
S. flaccida, Hook.	H.	x					x
Sagina apetala, L.	T.				x	x	x
Clematis microphylla, DC.	H.					x	
Ranunculus lappaceus, Sm.	H.	x	x		x	x	x
R. rivularis, Banks and Soland	H.	x					x
Cassytha glabella, R. Br.	E.	x	x	x			
C. melantha, R. Br.	E.	x	x	x	x	x	x
C. pubescens, R. Br.	E.				x	x	
Nasturtium palustre, DC.	H.					x	x
Cardamine hirsuta, L.	H.					x	
C. laciniata, F. v. M.	H.	x					
Drosera granduligera, Lehm.	T.						x
D. Whittakeri, Planch.	G.	x	x	x	x	x	x
D. pygmaea, DC.	T.					x	x
D. Menziesii, R. Br.	G.	x	x	x			
D. auriculata, Backh.	G.	x	x		x	x	x
D. peltata, Sm.	G.	x			x	x	x
Tillaea verticillaris, DC.	T.					x	
T. macrantha, Hook.	T.	x					
Pittosporum phillyraeoides, DC.	M.					x	
Bursaria spinosa, Cav.	M.	x			x	x	x
Marianthus bignoniaceus, F. v. M.	N.	x		x			
Billardiera cymosa, F. v. M.	N.	x		x			
Cheiranthera linearis, A. Cunn.	N.	x					
Rubus parvifolius, L.	N.	x					x
Acaena ovina, Cunn.	H.	x	x		x	x	x
A. sanguisorbae, Vahl.	H.	x					

	Life Form.	Stringy-bark.	Box.	Scrub (Mt. Cmps.)	Blue Gum.	Pepper-mint.	Red Gum
Acacia spinescens, Benth.	M.	x			x	x	
A. rupicola, F. v. M.	M.	x					
A. armata, R. Br.	M.	x			x	x	x
A. obliqua, Cunn.	M.				x	x	
A. retinodes, Schlecht.	M.	x			x		x
A. pycnantha, Benth.	M.	x			x	x	x
A. myrtifolia, Willd.	M.	x	x	x			
A. verniciflua, Cunn.	M.	x					
A. melanoxylon, R. Br.	M.	x			x	x	x
A. verticillata, Willd.	M.	x		x			x
Gompholobium minus, Sm.	N.	x	x	x			
Sphaerolobium vimineum, Sm.	N.			x			
Viminaria denudata, Sm.	M.			x			x
Daviesia corymbosa, Sm.	N.	x					
D. ulicina, Sm.	N.	x	x		x	x	
D. brevifolia, Lindl.	N.	x	x	x	x	x	
Pultenaea daphnoides, Wendl.	N.	x					
P. acerosa, R. Br.	N.	x					
P. largiflorens, F. v. M.	N.	x		x			
P. pedunculata, Hook.	N.			x			
P. graveolens, Tate	N.	x		x	x		
P. villifera, Sieber	N.			x			
P. villosa, Willd.	N.	x		x			
Eutaxia empetrifolia, Schlecht.	N.				x		
Dillwynia hispida, Lindl.	N.	x	x	x	x	x	x
D. ericifolia, Sm.	N.			x			
D. floribunda, Sm.	N.			x			
Platylobium obtusangulum, Hook.	N.	x	x	x	x		
Bossiaea prostrata, R. Br.	N.	x			x	x	x
Lotus australis, Andr.	H.				x	x	x
Indigofera australis, Willd.	N.				x	x	
Swainsonia lessertiifolia, DC.	H.				x		
Glycine clandestina, Wendl.	H.	x	x		x	x	
Kennedya prostrata, R. Br.	N.	x	x	x	x	x	x
Hardenbergia monophylla, Benth.	N.	x					
Geranium pilosum, Forst.	H.	x	x		x	x	x
Erodium cygnorum, Nees	T.					x	
Oxalis corniculata, L.	G.	x	x		x	x	x
Linum marginale, Cunn.	H.				x	x	
Correa speciosa, Andrews	N.	x	x	x			
Zieria veronicea, F. v. M.	N.			x			
Boronia caerulescens, F. v. M.	N.	x		x			
Geijera parviflora, Lindl.	N.			x			
Tetratheca ericifolia, Sm.	N.	x	x	x	x	x	
Comesperma volubile, Labill.	N.			x			
C. calymega, Labill.	H.				x	x	
Phyllanthus thymoides, Sieb.	N.			x			
Euphorbia Drummondii, Boiss.	T.					x	
Poranthera ericoides, Klotsch.	N.			x			
P. microphylla, Brongn.	T.	x		x	x	x	
Amperea spartioides, Brongn.	N.			x			
Stackhousia linarifolia, A. Cunn.	Ch.	x	x	x	x	x	x
Dodonaea viscosa, Jacq.	N.	x			x	x	x
Spyridium parvifolium, F. v. M.	N.	x					
S. subochreatum, Reiss.	N.	x					
S. spathulatum, F. v. M.	N.	x		x			
S. coactilifolium, Reiss.	N.	x		x			
S. vexilliferum, Reiss.	N.	x	x	x			
Cryptandra hispidula, Reiss.	N.	x			x	x	
C. propinqua, A. Cunn.	N.			x			
Thomasia petalocalyx, F. v. M.	N.				x	x	
Hibbertia sericea, Benth.	N.	x	x	x	x	x	x
H. stricta, R. Br.	N.	x	x		x	x	x
H. acicularis, F. v. M.	N.	x	x	x	x	x	x
H. virgata, R. Br.	N.				x		
Hypericum japonicum, Thunb.	H.	x			x	x	x

	Life Form.	Stringy-bark.	Box.	Scrub (Mt. Cmps.)	Blue Gum.	Pepper-mint.	Red Gum.
Viola hederacea, Labill.	H.	x		x	x		x
V. betonicifolia, Sm.	H.						x
Hybanthus floribundus, F. v. M.	N.	x	x	x			
Pimelea phylicoides, Meissn.	N.	x		x			
P. octophylla, R. Br.	N.	x		x			
P. glauca, R. Br.	N.	x	x	x	x	x	x
P. stricta, Meissn.	N.			x			
P. humilis, R. Br.	N.				x	x	
P. flava, R. Br.	N.			x			
P. Husseyeana, Tate	N.			x			
Lythrum hyssopifolium, L.	H.					x	x
Eucalyptus obliqua, L'Herit.	MM.	x					
E. capitellata, Sm.	MM.	x		x			
E. leucoxylon, F. v. M.	MM.				x		
E. odorata, Behr.	M.					x	
E. rubida, Deane and Maid.	MM.	x			x		x
E. elaeophora, F. v. M.	M.		x				
E. viminalis, Labill.	MM.	x			x	x	x
E. rostrata, Schlecht.	MM.				x		x
E. cosmophylla, F. v. M.	M.	x		x			
E. fasciculosa, F. v. M.	M.	x	x	x			
Leptospermum scoparium, Forst.	N.	x	x	x	x	x	x
L. lanigerum, Sm.	M.	x			x		x
L. myrsinoides, Schlecht.	N.	x	x	x	x	x	x
Callistemon salignus, DC.	M.						x
Melaleuca decussata, R. Br.	N.			x			
M. parviflora, Lindl.	M.					x	
Baekea diffusa, Sieb.	N.			x			
Calythrix tetragona, Labill.	N.	x	x	x	x	x	x
Epilobium glabellum, Forst.	H.	x			x	x	x
Halorrhagis tetragyna, Hook. f.	H.	x			x	x	x
H. teucrioides, DC.	H.				x	x	
H. ceratophylla, Zahlb.	H.	x			x	x	
H. heterophylla, Brongn.	H.				x	x	
Hydrocotyle laxiflora, DC.	H.	x					
H. hirta, R. Br.	H.				x		
H. callicarpa, Bunge	T.	x			x	x	x
Xanthosia pusilla, Bunge	H.			x			
X. dissecta, Hook.	H.			x			
Eryngium rostratum, Cav.	G.				x	x	
Daucus brachiatus, Sieb.	T.	x		x	x	x	x
Astroloma humifusa, Pers.	N.	x	x	x	x	x	x
A. Sonderi, F. v. M.	N.	x	x	x	x	x	
Lissanthe strigosa, Sm.	N.	x			x		
Leucopogon virgatum, R. Br.	N.	x	x	x	x	x	x
L. concurvum, F. v. M.	N.			x			
L. cordifolium, Lindl.	N.	x					
L. hirtellum, F. v. M.	N.	x					
Acrotriche serrulata, R. Br.	N.	x	x	x	x	x	x
A. fasciculiflora, Benth.	N.	x					
Epacris impressa, Labill.	N.	x		x	x		x
Samolus repens, Pers.	Ch.				x	x	x
Logania linifolia, Schlecht.	N.	x		x			
L. longifolia, R. Br.	N.	x					
Sebaea ovata, R. Br.	T.				x	x	
Erythraea spicata, F. v. M.	H.				x	x	x
Villarsia reniformis, R. Br.	HH.						x
Convolvulus erubescens, Sims	T.				x	x	
Wilsonia rotundifolia, Hook.	H.	x					
Halgania cyanea, Lindl.	N.				x		
Prunella vulgaris, L.	H.				x	x	x
Ajuga australis, R. Br.	H.				x	x	
Anthocercis angustifolia, F. v. M.	N.	x					
Gratiola peruviana, L.	H.	x			x	x	x
Veronica Derwentia, Andrews	N.	x					x
Euphrasia Brownii, F. v. M.	H.	x	x	x			

	Life Form.	Stringy-bark.	Box.	Scrub (Mt. Cmps.)	Blue Gum.	Pepper-mint.	Red Gum.
Polypompholyx tenella, Lehm.	T.					x	
Plantago varia, R. Br.	T.					x	
Opercularia varia, Hook. f.	Ch.	x			x	x	
O. scabra, Schlecht.	Ch.	x					
Asperula oligantha, F. v. M.	H.				x	x	x
Galium umbrosum, Soland.	H.	x	x		x	x	x
G. australe, DC.	T.				x	x	x
Wahlenbergia gracilis, DC.	T.	x	x	x	x	x	x
Velleya paradoxa, R. Br.	H.				x		
Goodenia amplexans, F. v. M.	N.	x					x
G. ovata, Sm.	N.	x	x	x			x
G. albiflora, Schlecht.	Ch.				x		
G. geniculata, R. Br.	Ch.	x			x	x	
G. pinnatifida, Schlecht.	H.				x	x	
Scaevola microcarpa, Cav.	Ch.	x	x		x	x	x
Dampiera rosmarinifolia, Schlecht.	Ch.	x					
Brunonia australis, Sm.	H.	x	x		x	x	
Stylidium graminifolium, Swartz.	Ch.	x		x			
S. calcaratum, R. Br.	T.					x	
S. despectum, R. Br.	T.				x	x	x
Olearia grandiflora, Hook.	Ch.	x					
O. tubuliflora, Benth.	N.	x	x		x	x	
O. Huegelii, Benth.	N.	x					
Vittadinia australis, A. Rich.	Ch.				x	x	
Minuria leptophylla, DC.	Ch.				x		
Lagenophora Billardieri, Cass.	H.				x	x	
Brachycome trachycarpa, F. v. M.	Ch.				x	x	
B. diversifolia, Fisch. and Mey.	Ch.				x	x	
Siegesbeckia orientatis, L.	T.	x					x
Flaveria australasica, Hook. f.	T.				x	x	x
Cotula coronopifolia, L.	T.						x
C. australis, Hook. f.	T.				x	x	
Isoetopsis graminifolia, Turcz.	T.					x	
Calocephalus Brownii, F. v. M.	Ch.				x	x	
Craspedia Richea, Cass.	H.	x	x		x	x	x
Rutidosis pumilo, Benth.	T.					x	x
Leptorrhynchus squamatus, Less.	Ch.	x	x	x	x	x	x
Helichrysum Baxteri, A. Cunn.	Ch.	x		x	x		
H. scorpioides, Labill.	Ch.	x		x	x		
H. lucidum, Henck.	Ch.	x					
H. Blandowskianum, Stretz.	Ch.	x		x			
H. apiculatum, DC.	Ch.	x	x	x	x	x	x
H. semipapposum, DC.	Ch.	x		x			
Helipterum exiguum, F. v. M.	T.					x	
Gnaphalium japonicum, Thunb.	H.	x			x	x	
Ixodia achilleoides, R. Br.	N.	x	x	x	x		
Erechthites arguta, DC.	T.			x			
E. quadridentata, DC.	H.				x	x	
E. hispidula, DC.	H.	x	x	x	x	x	
Senecio lautus, Soland.	Ch.	x			x	x	
S. hypoleucus, Benth.	N.	x			x		
S. brachyglossus, F. v. M.	T.					x	
Cymbanotus Lawsonianus, Gaud.	Ch.				x	x	x
Microseris Forsteri, Hook. f.	G.	x			x	x	x

IX.—APPENDIX B. LIST OF INTRODUCED PLANTS.

The following list gives the commoner introduced plants which occur as constituents of the flora of the forest communities. Weeds of roadsides and of cultivated land that do not enter the woods, and planted ornamental species, are not included.

The list makes no attempt at completion, but gives only those plants of more general occurrence.

The distribution is noted in five columns; four of these are the main forest types:– A, Stringybark; B, Blue Gum; C, Peppermint; D, Red Gum. The fifth column, E, contains those plants which are confined to creek-sides or to very wet spots. Where occurrence is confined to this column a general distribution in wet places is meant:—

List of Commoner Introduced Plants.

	A.	B.	C.	D.	E.
Pinus halepensis, Mill.			x		
P. maritima, Poir.	x	x			
P. insignis, Dougl.	x				
Aponogeton distachyus, Thunb.	x				x
Alisma plantago, L.	x				x
Phalaris minor, Retz.		x	x	x	
Anthoxanthum odoratum, L.	x	x	x	x	
Phleum pratense, L.			x	x	
Alopecurus agrestis, L.		x	x		
Agrostis verticillata, Vill.				x	
Arundo donax, L.	x			x	x
Lagurus ovatus, L.	x	x	x	x	
Holcus lanatus, L.		x	x	x	
Dactylis glomerata, L.	x	x	x	x	
Aira caryophyllea, L.	x	x	x	x	
Briza minor, L.	x	x	x	x	
B. maxima, L.	x	x	x	x	
Koeleria cristata, Pers.		x	x		
Avena fatua, L.			x		
A. sativa, L.			x		
Festuca myuros, L.		x	x		
F. bromoides, Sm.	x	x	x		
F. rigida, Kunth.			x		
Bromus maximus, Desf.	x	x	x	x	
B. unioloides, Humb.			x	x	
B. lectorum, L.			x		
B. sterilis, Ger.		x		x	
B. mollis, L.	x	x	x	x	
B. arvensis, L.			x	x	
Cynodon dactylon, L.		x	x	x	
Hordeum murinum, L.			x		
Juncus capitatus, Weig.	x			x	x
J. bufonius, L.	x		x	x	x
Zantedeschia aethiopica, Spreng.					x
Sparaxis tricolor, Ker.		x	x	x	
Romulea rosea, Eckl.			x		
R. parviflora, J. Britten			x		
Moraea xerospatha, MacOwen			x		
Homeria collina, Vent.		x	x		
Watsonia meriana, Mill.					x
Salix babylonica, L.					x
Urtica urens, L.			x		
Polygonum aviculare, L.		x	x		
Rumex crispus, L.	x	x	x	x	
R. acetosella, L.	x	x	x		
Silene gallica, L.			x	x	
Moenchia erecta, Gaertn.				x	
Stellaria media, L.			x	x	
Cerastium vulgatum, L.	x	x	x	x	
Sagina apetala, L.	x	x	x		
Papaver Argemone, L.			x		
Fumaria officinalis, L.		x	x		
Senebiera didyma, Pers.			x		
Potentilla anserina, L.				x	
Rubus fruticosus, L.	x				
R. laciniatus, Willd.	x				
Rosa rubiginosa, L.	x	x	x	x	

	A.	B.	C.	D.	E.
Crataegus oxyacantha, L.	x	x			
Ulex europaeus, L.	x	x		x	
Cytisus canariensis, Steud.	x			x	
C. scoparius, Link.	x				
Trifolium angustifolium, L.	x	x	x		
T. tomentosum, L.			x		
T. repens, Riv.	x	x	x	x	
T. procumbens, L.			x		
T. subterraneum, L.		x	x	x	
Medicago maculata, Willd.			x		
M. tribuloides, Desr.			x		
Geranium dissectum, L.	x	x	x	x	
G. molle, L.		x	x	x	
Erodium cicutarium, L.		x	x		
E. Botrys, Bertol.			x		
E. moschatum, L' Herit.		x	x		
O. cernua, Thunb.			x	x	
Malva parviflora, L.			x		
Hypericum perforatum, L.		x	x		
Foeniculum vulgare, Mill.	x			x	
Anagallis arvensis, L.	x	x	x		
A. coerulea, Lamk.	x	x	x		
Olea europaea, L.		x	x		
Buddleia Madagascariensis, Lam.	x				x
Erythraea centaurium, Pers...		x		x	
Vinca major, L.				x	
Gomphocarpus arborescens, R. Br. ..		x	x		
Convolvulus arvensis, L.			x		
Myosotis arvensis, Scop.			x		
Lithospermum arvense, L.		x	x		
Echium plantagineum, L.			x		
Verbena bonnarensis, L.	x			x	x
Lavendula stoechas, L.		x	x		
Teucrium botrys, L.		x			
Lycium campanulaceum, Mey.			x	x	
Solanum sodomaeum, L.			x	x	
S. nigrum, L.	x	x	x	x	
Verbascum virgatum, With.		x	x		
Bartsia latifolia, Sibth.			x		
Plantago lanceolata, L.	x	x	x	x	
Galium aparine, L.		x	x	x	
Scabiosa maritima, L.			x		
Erigeron linifolius, Willd.		x	x		
Inula graveolens, Desf.	x	x	x	x	
Carduus crispus, L.	x	x			
Cirsium lanceolatum, Scop.	x	x		x	
Calendula arvensis, L.		x	x	x	
Cryptostemma calendulacea, R. Br. ..			x	x	
Hypochoeris glabra, L.	x	x	x	x	
H. radicata, L.	x	x	x	x	
Taraxacum officinale, Weber				x	
Picris hieracioides, L.	x				

Postscript.

Since the manuscript of this paper went to press the second part of the "Flora of South Australia," by J. M. Black (Adelaide: Government Printer, 1924), has appeared. This deals with the families Casuarinaceae-Euphorbiaceae. Certain changes in the nomenclature of some common plants have been made. Unfortunately it is not possible to incorporate them in the text, but the more important are indicated below. In the body of this paper the names of dicotyledonous plants are, as a rule, those used in the "Flora of Extratropical

South Australia" (R. Tate, 1890). The following list gives the names as used by us together with the names as revised:—

Drosera Menziesii, R. Br., becomes *D. Planchonii*, Hook. f.

Tillaea becomes *Crassula*. The species *T. verticillaris*, in the sense used in Bentham, "Flora Australiensis," is a composite of *Crassula colorata*, (Nees) Ostenf., and *C. Sieberiana*, (Schultes) Ostenf. Both of these in the Mount Lofty Ranges, but were not distinguished by us.

Acacia retinodes, Schlecht, should be spelled *Ac. rhetinodes*.

Eutaxia empetrifolia, Schlecht, becomes *E. microphylla*, (R. Br.) J. M. B.

Correa speciosa, Andr., becomes *C. rubra*, Sm.

Geijera parviflora, Lindl., in the sense used by Tate, included *G. linearifolia*, (DC.) J. M. B. This is the species meant by us.

Tetratheca ericifolia, Sm., in the sense used by Tate, included *T. pilosa*, Labill. This is the species occurring in the Mount Lofty Ranges.

T. G. B. O.

Literature Cited.

Adamson, R. S., and Osborn, T. G. B.—
On the Ecology of the Ooldea District. Trans. Roy. Soc. S. Austr., xlvi., p. 539. 1922.

Black, J. M.—
A Naturalised Flora of South Australia. Adelaide. 1909.
Flora of South Australia, pt. I. Adelaide. 1922.

Collins, Marjorie I.—
On the Structure of the Resin Secreting Glands in some Australian Plants. Proc. Linn. Soc. N.S. Wales., xlv., p. 529. 1920.

Clements, F. E.—
Plant Succession. Washington. 1916.

Diels, E.—
Die Pflanzenwelt von West-Australien. Leipzig. 1906.

Fuller, G. D., and Bakke, P. C.—
Raunkaier's Life Forms, Leaf-size Classes, and Statistical Methods. Plant World, xxi., p. 25. 1918.

Howchin, W.—
The Geology of the Mount Lofty Ranges, pt. I., The Coastal District. Trans. Roy. Soc. S. Austr., xxviii., pp. 253-280. 1904.
The Geology of the Mount Lofty Ranges, pt. II. *Ibid*, xxx., pp. 227-262. 1906.
Description of a New and Extensive Area of Permo-Carboniferous Glacial Deposits in South Australia. *Ibid*, xxxiv., pp. 231-246. 1910.
The Evolution of the Physiographical Features of South Australia. Rept. Australasian Ass. Adv. Sci., Melbourne, xiv., pp. 148-178. 1913.

Hunt, H. A., Edited by—
Results of Rainfall Observations made in South Australia. Melbourne. 1918.

Maiden, J. H.—
A Critical Revision of the Genus Eucalyptus, vol. i. 1909.

Maiden, J. H., and Betche, E.—
A Census of New South Wales Plants. Sydney. 1916.

Osborn, T. G. B.—
Notes on the Flora around Adelaide, South Australia. New Phytologist, xiii., p. 111. 1914.
On the Habitat and Method of Occurrence in South Australia of two Genera of Lycopods hitherto unrecorded for the State. Trans. Roy. Soc. S. Austr., xlii., p. 1. 1918.

Pearsall, W. H.—
The Aquatic and Marsh Vegetation of Esthwaite Water. Jour. Ecology, vi., p. 53. 1917.

Rodway, L.—
Tasmanian Flora and Forest. Tasmanian Hand Book. Hobart. 1914.

Schimper, A. F. W.—
Plant Geography. Oxford. 1903.

Smith, W. G.—
Raunkaier's Life Forms and Statistical Methods. Jour. Ecology, i., p. 16. 1913.

Tate, R.—
Flora of Extra-tropical South Australia. Adelaide. 1890.

Taylor, E. G.—
The Australian Environment. Melbourne. 1918.

Taylor, N.—
A Quantative Study of Raunkaier's Growth Forms as illustrated by the 400 Commonest Species of Long Island, N.Y. Brooklyn Bot. Gdn. Mem., i., p. 486. 1918.

Teale, E. O.—
Soil Survey and Forest Physiography of Kuitpo, South Australia. Dept. of Forestry, Adelaide Univ., Bul. 6. 1918.

EXPLANATION OF PLATES X. TO XX.

PLATE X.

Fig. 1. High forest of *Eucalyptus obliqua* with *Xanthorrhoea semiplana, Lepidosperma carphoides,* and occasional bushes of *Hakea rostrata, Isopogon, Astroloma, Hibbertia,* etc. Kuitpo, July, 1922. T. G. B. O., photo.

Fig. 2. Forest of young *Eucalyptus obliqua* with dense shrubby undergrowth of *Acacia myrtifolia, Pultanea daphnoides,* and very numerous shrubs. Mount Lofty, Dec., 1913. T. G. B. O., photo.

PLATE XI.

Fig. 1. Regeneration of *Eucalyptus obliqua* after a fire 3-4 years previously, showing old trees shooting from dormant buds and numerous seedlings. Undergrowth of *Leptospermum myrsenoides* and numerous shrubs, *Lepidosperma,* etc. Mylor, Nov., 1922. R. S. A., photo.

Fig. 2. *Eucalyptus obliqua* forest about 7-8 months after a fire, showing regeneration from dormant buds and abundant flowering of *Xanthorrhoea semiplana.* Near Mount Lofty, Oct., 1912. T. G. B. O., photo.

PLATE XII.

Fig. 1. *Eucalyptus obliqua* regenerating about 3 years after a severe fire. Note numerous young trees and the abundance of *Ixodia achilloides* in flower foreground. Near Mount Lofty, Jan., 1913. T. G. B. O., photo.

Fig. 2. *Eucalyptus fasciculosa* on sunny quartzitic ridge locally replacing *Eucalyptus obliqua.* Dwarf undergrowth of *Hibbertia* and *Tetratheca.* National Park, Belair, May, 1913. T. G. B. O., photo.

PLATE XIII.

Fig. 1. Dwarf scrub of *Eucalyptus capitellata* with *Xanthorrhoea semiplana, Banksia ornata,* etc., on glacial soils. Black Swamp, May, 1914. T. G. B. O., photo.

Fig. 2. Dwarf scrub of *Eucalyptus capitellata* on hills and gully forest of *Eucalyptus obliqua* following stream and widening out at its head waters, where *E. fasciculosa* becomes dominant. Near Mount Compass, Oct., 1922. T. G. B. O., photo.

PLATE XIV.

Fig. 1. Stream-side community widening out into a swampy patch with *Phragmites* and *Typha*. The dense growth by the stream on the further side includes *Leptospermum lanigerum*. Right foreground and distance, *Eucalyptus obliqua* forest with *Xanthorrhoea*, *Acacia myrtifolia*, etc. Near Mount Lofty, Aug., 1922. T. G. B. O., photo.

Fig. 2. *Eucalyptus elaeophora* on ridge of Pre-Cambrian rock. Near Birdwood, Nov., 1922. R. S. A., photo.

PLATE XV.

Fig. 1. *Eucalyptus elaeophora* with undergrowth of *Lepidosperma semiteres* having the appearance of a tussock grass. Near Birdwood, Nov., 1922. R. S. A., photo.

Fig. 2. Open forest of *Eucalyptus leucoxylon* on lower slopes of Mount Lofty Range. In distance the crest of the main range is visible, Mount Lofty highest point on right; the dense timbering there is *Eucalyptus obliqua*. Some trees of *Eucalyptus viminalis* in foreground and along valley but not distinguishable from the blue gum. Near Adelaide, July, 1922. T. G. B. O., photo.

PLATE XVI.

Fig. 1. *Eucalyptus leucoxylon* with undergrowth of young *Acacia pycnantha*. Clare, Nov., 1913. T. G. B. O., photo.

Fig. 2. Savannah forest of *Eucalyptus leucoxylon*, some *E. viminalis*. The undergrowth is chiefly herbaceous, including *Stipa, Danthonia*. The trees in the foreground have been ringbarked to improve the pasture. Birdwood, Nov., 1922. R. S. A., photo.

PLATE XVII.

Fig. 1. Woodland of *Eucalyptus rubida* with undergrowth of *Acacia pycnantha*. Ambleside, July, 1922. T. G. B. O., photo.

Fig. 2. Woodland of *Eucalyptus odorata* with grassy and herbaceous undergrowth. Near Kapunda, Oct., 1917. T. G. B. O., photo.

PLATE XVIII.

Fig. 1. *Eucalyptus rostrata* growing by a waterhole in Inman Valley. Victor Harbour, Jan., 1920. T. G. B. O., photo.

Fig. 2. Swamp to left with *Eucalyptus rubida* and shrubby undergrowth, *Leptospermum scoparium*, etc. To right hill slope with *Eucalyptus obliqua*. Mylor, Nov., 1922. R. S. A., photo.

PLATE XIX.

Fig. 1. Extensive area of savannah forest, chiefly *Eucalyptus odorata*, ringbarked, trunks show white, and grazed. Photograph taken from crest of a ridge, tree to left foreground, *Casuarina stricta*, on shallow soil. Near Kapunda, Oct., 1917. T. G. B. O., photo.

Fig. 2. Dense growth of grasses, including *Themeda* and *Avena fatua*, 12 months after enclosing area against sheep. Hidden by grass are many tree seedlings. Foreground, this side of fence, grazing is allowed. Near Kapunda, Oct., 1917. T. G. B. O., photo.

PLATE XX.

Fig. 1. Impenetrable growth of *Rubus fruticosus, Cytisus canariensis*, and *Foeniculum vulgare* on silt-swamp land on banks of River Onkaparinga. The trees are *Eucalyptus rubida*. Mylor, Nov., 1922. R. S. A., photo.

Fig. 2. Natural regeneration of *Eucalyptus rostrata* on alluvial flat. This area was under cultivation 30-40 years ago; the plough marks can still be seen between the trees. Near Kuitpo, July, 1922. T. G. B. O., photo.

THE EXTERNAL CHARACTERS OF POUCH EMBRYOS OF MARSUPIALS.

No. 9.—PHASCOLOMYS TASMANIENSIS.

By Frederic Wood Jones, D.Sc., F.Z.S.,
Professor of Anatomy in the University of Adelaide.

[Read July 17, 1924.]

For the opportunity of examining the pouch young of the Tasmanian representative of the genus *Phascolomys* I am indebted to Prof. Thomson Flynn, of the University of Tasmania. The R.V. length of the specimen is 140 mm., and hair has made its appearance over the entire body, the hair pattern showing to the best possible advantage. In no outstanding feature does this young animal differ widely from the adult; and even much younger embryos, of other

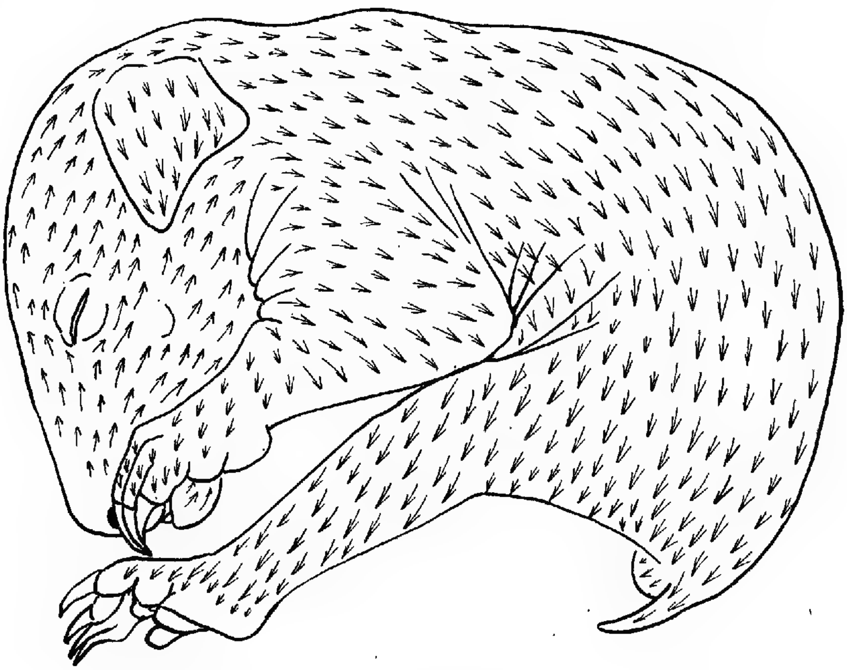


Fig. 1.
Phascolomys tasmaniensis.
General external characters of the embryo showing hair tracts.
Two-thirds natural size.

members of the genus which I have examined, are remarkable for their unmistakable likeness to the mature animals. The specimen is a female and is the only example of its species available for examination.

Hair Tracts.—The hair pattern over the whole of the head, body, and limbs is of basal simplicity; the primitive caudad and ventrad slope on the trunk, and the postaxial trend on the limbs, being everywhere preserved. This completely unaltered hair pattern in *Phascolomys* is worthy of note, since it differs so

entirely from the highly specialised condition present in *Phascolarctus* (see this series of papers, No. 5). Between *Phascolomys* and *Phascolarctus* there are some undoubted anatomical likenesses, and some authors have been, perhaps

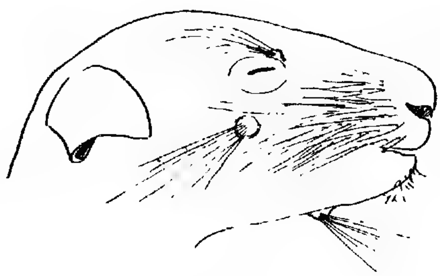


Fig. 2.
Phascolomys tasmaniensis.
Facial vibrissae. Half natural size.

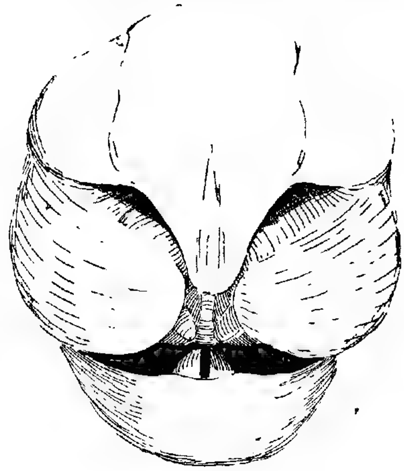


Fig. 3.
Phascolomys tasmaniensis.
Characters of the rhinarium. Twice natural size.

unduly, impressed by these similarities. Before the superficial likenesses between the two animals influence our judgment as to their near kinship, we must certainly not disregard the total unlikeness of their hair pattern.

Sensory Papillae and Vibrissae.—All the facial sets are well developed (see fig. 2); the papillae being large and prominent, and the vibrissae, even at this

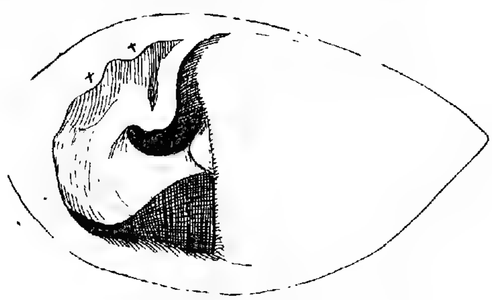


Fig. 4.
Phascolomys tasmaniensis.
Characters of left auricle. Twice natural size.

early stage, being coarse and stiff. There are five supraorbital vibrissae springing from a well-marked supraorbital papilla situated not far behind the anterior (inner) canthus of the eye. Seven stout and elongated genals arise from a large papilla which is also situated somewhat anterior to its usual position. The interramal papilla is large, elongated from side to side, and gives rise to about a dozen vibrissae, of which there are three long and three short bristles on each side. The mysticials are arranged in many (more than 6) rather ill-defined

rows, the individual vibrissae are long and coarse, the longest reaching well past the eye. The submentals are short and curved forwards. No definite papilla marks their site of origin.

Brachial Vibrissae.—The ulnar carpal papilla is well developed and it gives rise to a couple of stout bristles. No other vibrissae can be detected.

Rhinarium.—The naked area is extensive. The skin is almost smooth, the granulations being very ill-defined. The nostrils are slit-like and their lower naked margins are only slightly marked off from the hairy maxillary processes (see fig. 3). The apex of the naked wedge-shaped rhinarium is rounded and

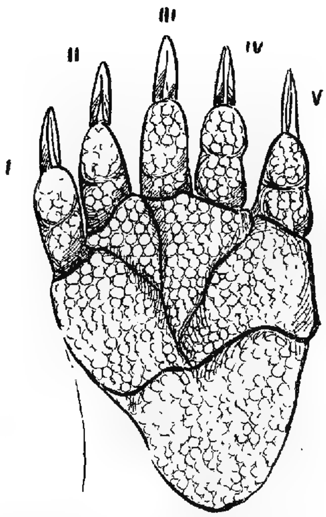


Fig. 5.
Phascolomys tasmaniensis.
Palmar aspect of left manus.
Twice natural size.

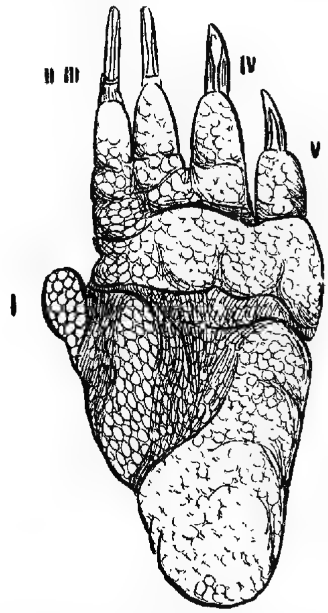


Fig. 6.
Phascolomys tasmaniensis.
Plantar surface of left pes.
Twice natural size.

falls considerably short of the maxillary processes, so that the upper lip is deeply cleft in the middle line over the upper incisor teeth. There is no median groove on the rhinarium. There are no likenesses, save extremely superficial ones, to the rhinarium of *Phascolarctus.*

The External Ear.—The auricle is by no means the simple structure that the descriptions of Pocock would lead us to suppose. To speak, as this author does, of "the complete or almost complete disappearance of the supratragus" is quite incorrect, and such a statement can only have arisen from the examination of unsatisfactory material. Upon the mandibular portion of the helix there are two ill-defined tragoid projections (marked x x in fig. 4). The hyoid portion of the antihelix is complex and folded, with a well-marked processus antihelicis separated from a secondary process by a deep sulcus. The sculpturing of the auricle is considerably diminished in the adult animal, but if by "supratragus" the upper portion of the antihelix is meant, we can only admit that this structure has by no means disappeared.

The Manus.—The manus is relatively large and spatulate, bearing an obvious imprint of its adult application to the process of digging (see fig. 5). The whole palmar surface is naked and coarsely granulated. The pads are distinct. Digital

pad 1 is fused with the thenar pad. Digital pads 2, 3, and 4 are discrete. The hypothenar pad is large and constitutes the bulk of the proximal portion of the palm. The digits are short and strong, and armed with powerful curved claws. The digital formula is $3 > 4 > 2 > 5 > 1$, as in the adult.

The Pes.—The pes shows an entirely naked and coarsely granulated sole, on which the pads are not distinctly delimited. Digit 1 is reduced to a nailless, fleshy knob. The syndactylous digits 2 and 3 are especially well developed (see fig. 6). The claws of digits 2, 3, 4, and 5 are curved and elongated, those of the syndactylous digits being the longest and most slender of the series. The digital formula is $2 \cdot 3 > 4 > 5 > 1$, as in the adult.

Pouch and Mammary Area.—The pouch is shallow at its cephalic and caudal ends; deepened laterally, especially behind, so as to be, at this stage,

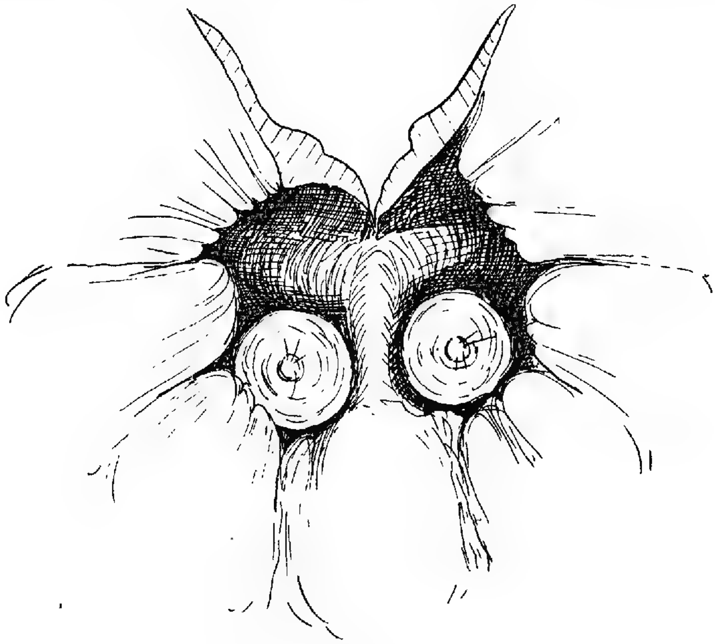


Fig. 7.
Phascolomys tasmaniensis.
Pouch and nipples. The anterior margin of the pouch has been slit, in order to open the mouth more completely.

distinctly bilocular. The orifice of the pouch is of a smaller diameter than the depth of the cavity only at the front and sides. At the posterior margin the skin surface of the abdomen merges gradually to the cavity of the pouch as a median elevation between the two mammary areas. This median elevation, which partly subdivides the cavity into right and left mammary pockets, spreads out on the floor of the pouch cephalad to the mammary areas, and so forms a torus which limits the mammary pockets anteriorly. The nipples themselves are very large and prominent, their apices protruding into the mouth of the unopened pouch. Each nipple is in the shape of a little cone, and from its apex a few short bristle hairs project.

External Genitalia.—The tip of the genital tubercle is practically hidden within the prominent margins of the cloaca.

SOME NEW RECORDS OF FUNGI FOR SOUTH AUSTRALIA. PART III.

TOGETHER WITH A DESCRIPTION OF TWO NEW SPECIES OF PUCCINIA.

By Geoffrey Samuel, B.Sc.,
Lecturer on Plant Pathology, University of Adelaide.

[Read July 17, 1924.]

Plates XXI. and XXII.

Further new records of parasitic fungi occurring in South Australia are presented in this paper. These, together with the records listed in two previous papers (Osborn, 1915; Osborn and Samuel, 1922), and those to be found in MacAlpine's various books on Australian fungi, bring our knowledge of the parasitic fungus flora of this State up to date. A complete card index of all fungi recorded for the State, together with an index of host plants, has now been established in the Laboratory of Plant Pathology of the University, and records of distribution are continually being added.

Many of the fungi recorded in the present paper were collected by Prof. T. G. B. Osborn, and his valuable field notes have in many instances been incorporated in the text. Owing to his thorough collecting of fungi on his long journeys into the interior in connection with the ecology of the saltbush areas, we are gaining a much more complete knowledge of the fungi attacking plants of the arid regions. The aecidial stage in the life-cycle of three different rusts, and two new species of rusts, have thus been contributed by him, and are now described for the first time. One of these new rusts the author has pleasure in naming after him.

It is also a pleasure to record the gift to the Laboratory of Plant Pathology of the University, by Prof. J. B. Cleland, of his herbarium of parasitic fungi collected in Australia. Several new records for the State of South Australia were contained in this collection, and these have been incorporated in the present paper.

The paper adds sixty records to the host index of South Australia, and twenty-three of these involve fungi not hitherto recorded for the State. The majority of the fungi listed are plant parasites, most of them indigenous. The record of their occurrence in this State means an extension of our knowledge of their geographical range in Australia. There is undoubtedly much still to be learnt in this direction, however, for practically every excursion into the country yields some new specimen. Our knowledge of the saprophytic fungi which occur in South Australia, even of such easily visible forms as many bark-dwelling Ascomycetes, is as yet negligible.

Attention may be called to the following new descriptions. The aecidial stage is described for the first time for *Puccinia kochiae, Uromyces atriplicis,* and *Uromyces vesiculosus*. The last of these is particularly interesting, as the aecidia were only found on the cotyledons and hypocotyl of young seedlings, and the bearing of this on the life-history of the fungus is discussed. In each of these three cases the connection between the aecidia and the rusts in question has been assumed from the two stages having been found together on the same

plants. No experimental evidence of connection was attempted. The spermogonia of *Puccinia morrisoni* on *Pelargonium australe* are described. Two new species of *Puccinia* are described, one occurring on members of the genus *Bassia*, and the other on *Olearia rudis*. The writer is indebted to Mr. C. C. Brittlebank, of the Department of Agriculture of Victoria, for comparing the two new species of rusts with material on related hosts in the herbarium of the Department in Melbourne.

Uromyces salsolae, Reich., has not been recorded for Australia before.

Seven of the fungi listed were collected near Broken Hill, in New South Wales, on a trip which Prof. Osborn made in 1918, and some of them are new records for that State also. They are the following:—*Puccinia bassiae, P. calotidis, P. tasmanica, Uromyces salsolae, Uromycladium tepperianum, Ustilago comburens, Erysiphe cichoracearum.*

Following the arrangement of the previous lists, reference is given to MacAlpine's Systematic Arrangement of Australian Fungi, by the number assigned there, and also, where possible, to other of MacAlpine's works, in order to render it easy to ascertain the range of a species in other States.

UREDINEAE.

Puccinia aucta, Berk. and F. v. M. III. On leaves, stems, and fruit-vessels of *Lobelia anceps*, L. Cape Jervis Peninsula, Jan., 1924, J. G. Wood. Aecidia have been found on various Lobelias in the Eastern States, but teleutospores have been described only from one collection in South Australia, which bore no aecidia. As these spore forms occurred (separately) on the same species *(L. anceps)*, MacAlpine considered it justifiable to unite the two under the name *Puccinia aucta.* It is curious that teleutospores have again been found in South Australia with no aecidia, and that teleutospores have not yet been reported from the Eastern States where the aecidia occur. It seems just possible that there may be no connection between the teleutospore rust in South Australia and the aecidia found on Lobelias in the Eastern States.

Cunningham also finds teleutospores only present in New Zealand, and considers that there is no connection between these and the aecidia.

The teleutospores on the present specimen were extremely variable (fig. 1). Three-celled teleutospores were common; the development of a small upward-growing process from the lower cell was frequent; two teleutospores on one stalk were seen in one instance; numerous types of deformation were to be met with on all the specimens. It is possible that the sori were infected with *Darluca filum;* this parasite was observed on the sori on a few plants, but could not be detected on those from which the figures of spores were drawn.

Teleutospores brownish-yellow, average 60-70×20-25 μ; when triseptate may reach a length of 100 μ. (McAlp., 1906, p. 148.)

Puccinia bassiae, n. sp.

I. Aecidia in small clusters on the cylindrical-clavate, often woolly, leaves. Pseudoperidia white, reflexed and laciniate at the margin; peridial cells oblong, angular, variable, densely punctate and finely striate at the margin, 24-45×22-30 μ. Aecidiospores subglobose to polygonal, orange, 21-28 μ diam.

II. Uredosori amphigenous, circular or elliptical, up to 1 mm. in diam., surrounded by the ruptured epidermis, convex, brown; uredospores subglobose to oval, yellowish to yellowish-brown, with numerous germ-pores (5 to 10) on each face, 23-36×21-25 μ, average 27×23 μ.

III. Teleutosori mainly on stems, variable in size from ½ to 4 mm., usually aggregated on definite lesions and bursting the cortex, elongated, compact, black.

Teleutospores densely packed, elliptic-oblong, rounded at both ends, smooth, deep chestnut-brown, slightly constricted at the septum, 32-46×20-31 μ, average 38×23 μ. Pedicel persistent, slightly tinted, variable in length to over 100 μ.

X. Mesospores rare.

I., II., III. On *Bassia paradoxa*, (R. Br.) F. v. M. Stephens Creek, near Broken Hill, N.S. Wales, Aug., 1918, T. G. B. O. (fig. 2).

II., III. On *Bassia uniflora*, R. Br. Stephens Creek, Aug., 1918, T. G. B. O.

II., III. On *Bassia decurrens*, J. M. Black. Stephens Creek, Aug., 1918.

II., III. On *Bassia obliquicuspis*, R. H. And. Silverton, N.S. Wales, Aug., 1918, T. G. B. O.

II. On *Bassia uniflora*, R. Br. Beltana, South Australia, May, 1920, T. G. B. O.

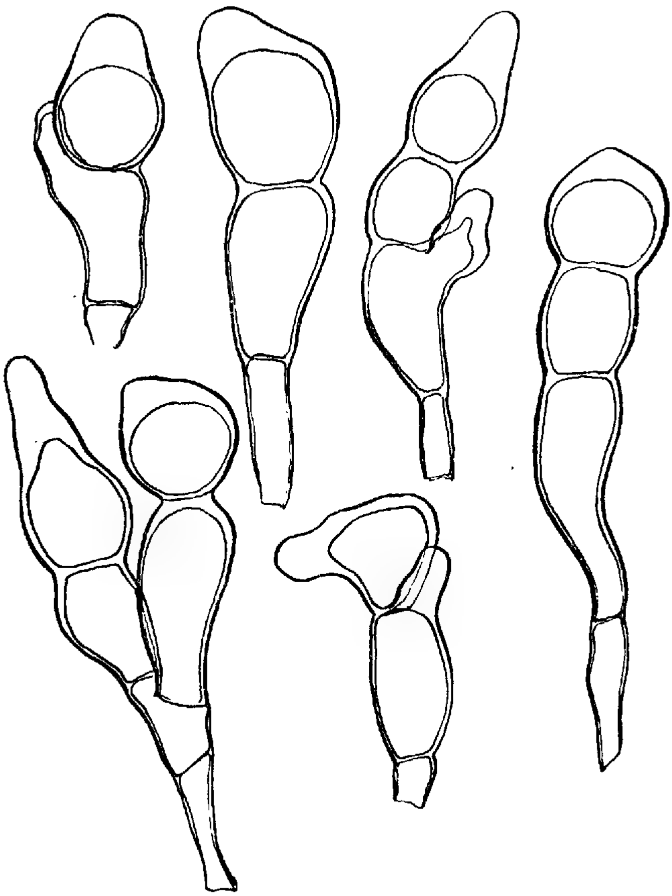


Fig. 1.
Puccinia aucta, Berk. and F. v. M.
Teleutospores showing abnormalities
(×610).

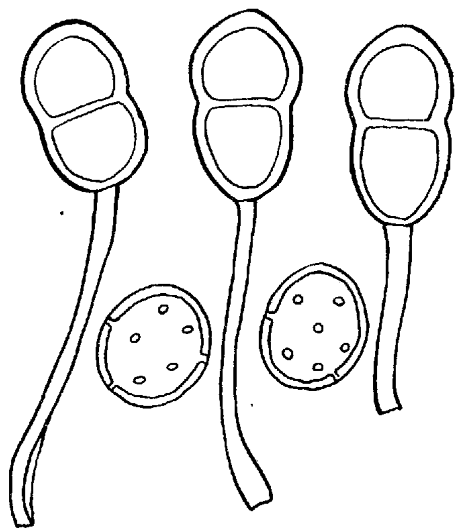


Fig. 2.
Puccinia bassiae, n. sp.
Uredospores and teleutospores
(×610).

One cannot but be struck by the resemblance of this rust to *Puccinia kochiae*, Mass., and yet the two can always be recognised apart. The teleutospores of the rust on *Bassia* are rather smaller and darker brown, and slightly more constricted at the septum, and the uredospores are smaller and more globular than

those of *Puccinia kochiae.* On the other hand, the form of the teleutospores is practically the same as in the Kochia rust, and the numerous germ-pores on the uredospores are a characteristic feature in both. Such resemblances would suggest that one of these rusts has arisen from the other. Although species of these two genera of host plants frequently grow intermixed, no specimens of both rusts collected in the same locality have yet been received. It therefore seems justifiable to place the new rust on *Bassia* in a separate species.

Puccinia bromina, Eriks. II., III. On *Bromus maximus,* L. Mylor, Nov., 1922, T. G. B. O. (McAlp., 1906, p. 116.)

Puccinia cacao, McAlp., II. On *Rottboellia compressa,* L. Inman River, Jan., 1924, J. B. C. (McAlp., 1906, p. 117.)

Puccinia calotidis, McAlp. I., III., X. On *Calotis hispidula,* F. v. M. Stephens Creek, near Broken Hill, N.S. Wales, Aug., 1918, T. G. B. O. The fungus was very common on its host in claypans. Also on *Calotis cymbacantha,* F. v. M. Curnamona, Aug., 1923, T. G. B. O. Both these are new host species for the fungus. (McAlp., 1906, p. 152.)

Puccinia cynodontis, Desm. II. On *Cynodon dactylon,* Pers. Inman Valley, Jan., 1922, T. G. B. O. Uredospores all of the subglobose, nearly smooth, thick-walled type. (McAlp., 1906, p. 118.)

Puccinia Dampierae, Syd. I. On *Dampiera lanceolata,* A. Cunn. Halidon, Nov., 1918, W. J. Spafford. This is a new host species for the fungus. (McAlp., 1906, p. 146.)

Puccinia graminis, Pers. II., III. On *Lolium perenne,* L. Forest Range, Feb., 1924, G. S. *Lolium* is not recorded as a host by MacAlpine, though known in Europe. Uredosori abundant on the green leaves, and teleutosori abundant on last year's dried inflorescence stalks. Also III., on *Hordeum murinum,* L. Pinnaroo, April, 1924, G. S. (McAlp., 1906, p. 120.)

Puccinia hypochoeridis, Oud. III. On *Hypochoeris glabra,* L. Pinnaroo, Nov., 1923, G. S. Common among thin wheat crops. (McAlp., 1906, p. 159.)

Puccinia kochiae, Mass. I., II., III., X. On leaves and stems of *Kochia triptera,* var. *erioclada,* Benth. Ooldea, Aug., 1923, T. G. B. O. (fig. 3).

The aecidial stage of this rust, which has not been described before, was found in abundance on patches of this new host plant just within the sandhills bordering the Nullarbor Plain. The uredosori and teleutosori are described by MacAlpine as being amphigenous, discoid, up to 1 mm. diam. In the Ooldea specimens a most noticeable feature was the large, compact, erumpent teleutosori on the stems (fig. 3), up to 4 cms. in length. Small discoid sori also occurred on the leaves. In a specimen of this rust on *Kochia villosa,* kindly sent us by Mr. C. C. Brittlebank from Victoria, there are large erumpent uredosori on the stems. It seems probable that such uredosori might later become teleutosori, and that the Ooldea specimens, if they had been collected earlier, would have shown uredosori on the stems. The spore measurements of our specimens are slightly larger than those given by MacAlpine, but as the form of the uredospores and teleutospores agrees exactly there seems no justification for separating the fungus as a new species.

I. **Aecidia** in clusters, projecting on all sides of the cylindrical-clavate leaves, elongated, cylindrical, up to $\frac{3}{4}$ mm. long, with recurved, laciniate margin. Pseudoperidia smooth, white, appearing orange in the tubular portion owing to the aecidiospores within; peridial cells oblong, polygonal, many almost rectangular, thick-walled, densely punctate, with striate margins, 28-45×23-36 μ, average 40×27 μ. Aecidiospores subglobose to polygonal, 22-31 μ diam.

II. Uredosori amphigenous, discoid, compact, slightly convex, surrounded by the ruptured epidermis, up to 2 mm. diam., reddish-brown; uredospores elliptical, golden-brown, with numerous germ-pores (5 to 10) scattered over each face, 30-40×22-30 μ.

III. Teleutosori on leaves discoid, compact, convex, up to 3 mm. diam., deep brown-black; on stems forming black erumpent cushions up to 3 cms. long, divided by strands of the ruptured cortex. The swellings caused by these teleutosori on the stems may attain a diameter two to three times that of the healthy stem, so that they may almost be described as galls. Teleutospores densely packed, often intermixed with uredospores, elliptic-oblong, rounded at both ends, in some spores so much thickened at the apex that the upper cell is almost obliterated, smooth, chestnut-brown, scarcely or not constricted at the septum,

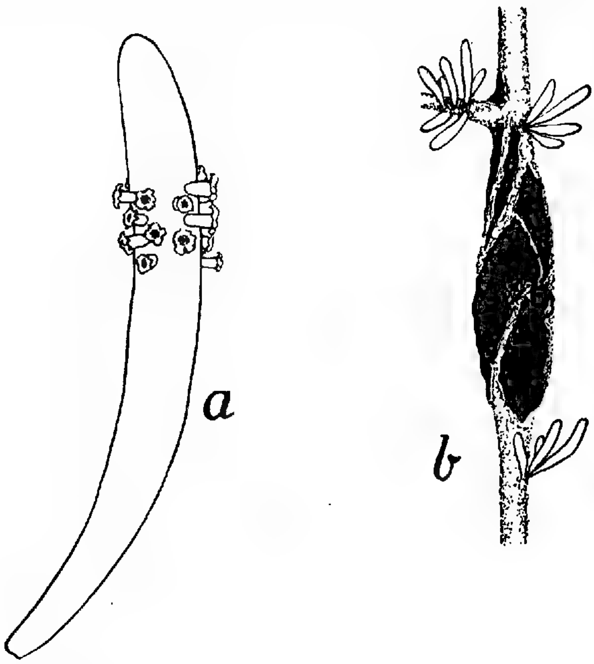


Fig. 3.
Puccinia kochiae, Mass. *a*, Aecidia on leaf (×6).
b, Teleutosorus on stem (×1½). Semi-diagrammatic.

40-50×27-35 μ, average 45×29 μ. Pedicel persistent, slightly tinted, variable in length from very short up to 100 μ.

X. Mesospores rare.

Also II., on *Enchylaena tomentosa*, R. Br. Port Elliot, Jan., 1919, T. G. B. O. Sceales Bay, West Coast, Jan., 1922, T. G. B. O. (McAlp., 1906, p. 176.)

PUCCINIA LOLII, Niels. II., III. On *Holcus lanatus*, L. Forest Range, Feb., 1924, G. S.

Puccinia lolii, Niels., and *Puccinia coronata*, Cord., are both "crown rusts," with finger-like processes from the tops of the teleutospores. In Europe *P. lolii* has its aecidial stage on *Rhamnus cathartica*, and *P. coronata* has aecidia on *Rhamnus frangula*. Grove (p. 254) says: "The two rusts occur on different grasses, except that both are found on the two species of *Holcus*. Aside from the distinction of hosts they can be separated only by minute differences. When they occur on *Holcus*, therefore, the only test that could absolutely decide the

matter would be to await the maturation of the teleutospores, and then try which of the two species of *Rhamnus* they would infect."

As *P. lolii* has been recorded for this State before, and as *P. coronata* is not listed by MacAlpine for Australia, the present specimens are assigned to the former, as being the most probable. The bright orange uredosori were literally covering the leaves; teleutosori were beginning to be formed. (McAlp., 1906, p. 123.)

Puccinia longispora, McAlp. II., III. On *Carex gaudichaudiana,* Kunth. Mylor, Nov., 1922, T. G. B. O. (McAlp., 1906, p. 135.)

Puccinia Morrisoni, McAlp. O., I., II., III., X. On *Pelargonium australe,* Jacq. Port Noarlunga, May, 1924, Miss I. Davies.

All stages of this rust were found on wild *Pelargonium* in a deep, sheltered hollow in the sandhills. MacAlpine records aecidia only from one locality, the Murramurrangbong Ranges; he does not mention spermogonia, so that the following additional notes may be given.

Spermogonia appearing first on slightly yellowish spots (2 to 5 mm. in diam.) on the leaves; spermogonia minute, punctiform, clustered, orange-brown, becoming black, amphigenous, though often on the upper surface only, 130-150 μ diam. Spermatia minute, oval, 2-3 μ. Aecidia arising later in clusters beneath spermogonial groups, occasionally amphigenous, and intermixed with, or surrounding, the spermogonia. Uredosori scattered, amphigenous; in these specimens even more frequent on the upper than the under surface. (McAlp., 1906, p. 180.)

Puccinia Osborni, n. sp.

I. Aecidia amphigenous, usually in clusters on slightly yellowish spots on the leaves; on older leaves infected tissue sometimes dries so that aecidia are left seated on circular dead spots 4-8 mm. diam. Pseudoperidia cup-shaped, scarcely projecting, with small white, fringed margin; peridial cells firmly united, overlapping, slightly elongated, polygonal, punctate with striated margin, $20\text{-}25 \times 15\text{-}20\ \mu$. Aecidiospores subglobose to polygonal, orange-yellow, smooth, $14\text{-}18 \times 13\text{-}16\ \mu$.

III. Teleutosori frequently surrounding aecidial groups in a single circle, sometimes less regularly placed, intermixed; black to blackish-brown, long covered by epidermis, compact, round to elongated, sometimes confluent, pulvinate, ca. $\frac{1}{2}$ mm. diam.

Teleutospores variable, oblong to clavate, chestnut-brown, upper cell darker than the lower, constricted at the septum, smooth, $30\text{-}54 \times 18\text{-}25\ \mu$, average $45 \times 22\ \mu$; occasionally tricellular, when up to 65 μ long. Upper cell deep chestnut-brown, rounded, or somewhat ovate, conoid or truncate, rather variable, considerably thickened at the apex; lower cell lighter in colour, of lesser diameter, tapering at the base, or sometimes rounded, on the average about the same length as the upper cell, though often relatively elongated. Pedicels persistent, hyaline to pale yellow, usually $\frac{1}{3}\text{-}\frac{2}{3}$ the length of the spore.

X. Mesospores occasional, deep chestnut-brown, clavate, thickened at the apex, $35\text{-}40 \times 20\text{-}27\ \mu$.

On *Olearia rudis,* F. v. M. (syn. *Aster exul,* Lindl.), var. *glabriuscula* (fig. 4).

Two rusts are recorded on Olearias by MacAlpine: *Puccinia oleariae,* McAlp. (II., III., X.), on *O. argophylla* and *Aecidium oleariae,* McAlp. (I.), on *O. axillaris.* The present rust differs from the former in having aecidia and no uredospores, being of the I., III., X. type, like *P. saccardoi* and *P. tasmanica,* in which the teleutospores are formed intermixed with or surrounding the old aecidia, on the same mycelium. The teleutospores, moreover, bear no resemblance

to those of *P. oleariae.* It differs from the latter in that teleutospores have never been found to follow the aecidia in *Aecidium oleariae,* which is probably, though not necessarily, a "two-cycle" rust of which the II., III. stage has not yet been discovered. I., III., X. rusts do sometimes produce aecidia after aecidia several times, however, so that it is possible that teleutospores may later be found intermixed with the aecidia of *Aec. oleariae.* The aecidia, peridial cells and aecidiospores of the present rust, however, are all considerably smaller than those of *Aec. oleariae,* the pseudoperidium is not so strongly reflexed and laciniate, and the aecidia are usually in circular spots on the leaves, and not embedded in a woody stem as in *Aec. oleariae.* These considerations seem amply sufficient to warrant the placing of this rust in a new species.

Two other rusts *(Puccinia Atkinsonii,* G. H. Cunn., on *Olearia excorticata,* Buch., and *Puccinia novae-zealandiae,* G. H. Cunn., on *Olearia Forsteri,* Hook. f.) have been described on Olearias by Cunningham in New Zealand, but both differ from the present specimens.

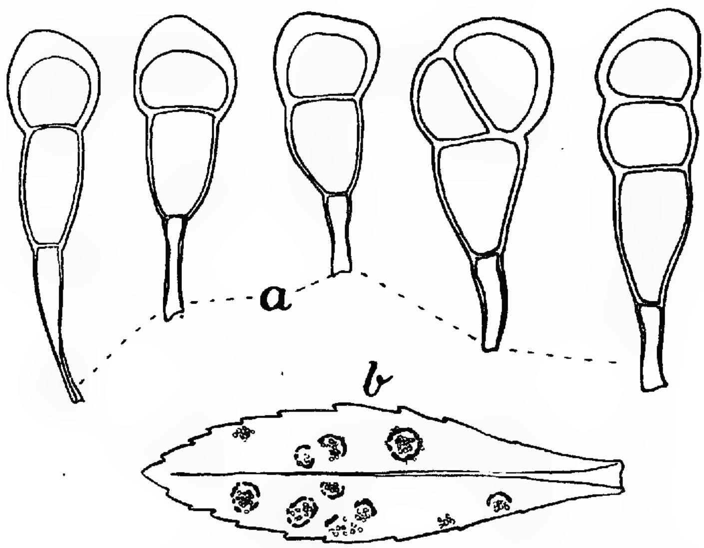


Fig. 4.
Puccinia Osborni, n. sp. *a,* Teleutospores (×610). *b,* Aecidia and teleutosori on leaf of *Olearia rudis,* F. v. M., var. *glabriuscula.* (Nat. size.)

Rusts bearing a considerable morphological resemblance to one another have been described on several members of the family Compositae. As examples may be cited *Puccinia tasmanica, P. erechtites, P. vittadineae, P. calotidis,* the new rust *P. osborni,* and perhaps *P. calocephalus* and others. How far they may be identical could only be proved by cross-inoculation experiments. Meanwhile it is a matter of convenience to name those on genetically separated genera as different species.

It seems quite possible that some of these rusts have had a common origin, and that they may now be biologically specialized towards their respective hosts; perhaps also the beginnings of morphological specialization could be established by a thorough comparative examination. It is probable that more affinity would be found between those occurring on the more closely related host-genera. *Senecio* and *Erechthitis* both fall in the sub-section *Astereae-Asterinae* of the Compositae;

Vittadinia, Olearia, and *Calotis* are in the *Senecioniae-Senecioninae*; *Calocephalus* is in the *Inuleae-Angianthinae*.

It may be noted also that both MacAlpine and Brittlebank remark that it is strange that a new rust *(Puccinia tasmanica)* should have been found on an introduced weed *(Senecio vulgaris)* in Australia, and it would suggest that a native rust had crossed over to this host. Our knowledge of such "jumps," and of the degree of biological and morphological specialization which may follow them, is still almost negligible.

PUCCINIA SACCARDOI, Ludw. I., III. On leaves and peduncles of *Velleya paradoxa*, R. Br. Belair, Oct., 1922, G. S.

Also on leaves and stems of *Scaevola microcarpa,* Cavan. Belair, Nov., 1912, T. G. B. O.; Mount Lofty, June, 1924, J. B. Cleland. This rust has not yet been recorded on the genus *Scaevola*, MacAlpine giving only *Goodenia* and *Velleya* species as hosts. It seems to be comparatively rare on this host, as it has only been collected twice, though occurring close to Adelaide. In the first specimen *Darluca filum* was parasitic on the aecidial patches, even fruiting within the aecidial cups. (McAlp., 1906, p. 147.)

PUCCINIA SUBNITENS, Diet. II. On *Distichlis spicata,* (L.) Greene (syn. *D. maritima,* Rafin.). Hindmarsh River, Jan., 1923, T. G. B. O. Uredospores only present; these correspond exactly with the description given by MacAlpine for this species, except that the uredosori are all epiphyllous, while MacAlpine describes them as hypophyllous. In this connection it may be remarked that the sides of the leaves of *Distichlis spicata* curve together over the upper surface on drying, instead of over the lower, as is the case in the majority of grasses. (McAlp., 1906, p. 131.)

PUCCINIA TASMANICA, Diet. I., III. On *Senecio brachyglossus,* F. v. M. Stephens Creek, near Broken Hill, N.S. Wales, Aug., 1918, T. G. B. O. III., on *Senecio brachyglossus,* F. v. M. Pinnaroo, Nov., 1923, G. S. I., III., on *Senecio lautus,* Sol. Pinnaroo, April, 1924, G. S. (McAlp., 1906, p. 163.)

PUCCINIA XANTHOSIAE, McAlp. II., III., X. On *Xanthosia pusilla,* Bunge. Mount Lofty, Mar., 1924, J. B. Cleland. Uredospores somewhat smaller than MacAlpine's measurements; average $31 \times 22\ \mu$. Teleutospore pedicels also longer, about $40\ \mu$.

Uromyces atriplicis, McAlp. I., III. On leaves, petioles, and fruit capsules of *Atriplex vesicarium,* Haw. Coonamore, Aug., 1923, T. G. B. O. plate xxi., fig. 1).

The aecidia of this rust have not been described before. They were found in great abundance all over certain bushes of the above host-plant, while surrounding bushes showed only teleutosori. There were also teleutosori on the bushes bearing aecidia. The growth of the aecidia-bearing bushes was rather abnormal, being more sappy than that of normal bushes, having more axillary shoots, giving a sort of witches-broom appearance, and having many of the fruit capsules enlarged and deformed. Aecidia were present in about equal abundance all over the bushes, practically every leaf being covered by them. These observations would suggest that the aecidium-bearing mycelium might be perennial, eventually permeating the whole plant. This stage of the fungus seems to be rare, however.

It is curious that uredospores were not found, but it is possible that this may be a matter of the age of the sori, and that if the fungus had been collected some months earlier uredospores might have been present.

I. Aecidia scattered fairly evenly over the whole of the under surface of practically every leaf on infected plants, $\frac{1}{2}$ to $\frac{3}{4}$ mm. diam., but often smaller towards the edges of the leaves; at first papillate, then bursting at the apex; the

white pseudoperidium at first incurved, but gradually becoming recurved and fimbriate with age. Peridial cells irregularly packed, polygonal, densely punctate and striate at the margins, 30-45×22-31 μ. Aecidiospores orange, subglobose to broadly elliptical, 20-30×17-22 μ, average 25×21 μ.

III. Teleutosori on plants bearing aecidia, or on plants with no aecidia, amphigenous, minute, compact, surrounded by the ruptured epidermis, deep reddish-brown, sometimes appearing almost black, up to 1 mm. diam. Teleutospores subglobose to shortly ellipsoid, finely striated longitudinally, slightly thickened at the apex, with prominent single apical germ-pore, dark-brown, 22-30×20-27 μ, average 26×25 μ. (McAlp., 1906, p. 100.)

UROMYCES PHYLLODIORUM, (B. and Br.) McAlp. II. On phyllodes of *Acacia penninervis,* Sieber. (pl. xxi., fig. 2). The uredosori surround the spermogonia, being seated on swollen tubercles, as in the original specimens from Queensland. MacAlpine says that in Victorian specimens spermogonia are wanting, the uredosori being scattered over the surface of the phyllode. (McAlp., 1906, p. 95.)

UROMYCES SALSOLAE, Reich. II., III. On *Salsola kali,* var. *stroblifera,* Benth. Near Broken Hill, N.S. Wales, Aug., 1918, T. G. B. O. On *Salsola kali,* L. Corona, N.S. Wales, Aug., 1921, Miss M. Collins. Also at Curnamona and Koonamore, South Australia, Aug., 1923, T. G. B. O.

Uredosori and teleutosori on leaves and stems, circular or elliptical, up to 1 mm. or more in diam., surrounded by the ruptured epidermis; the former brown, the latter almost black. Uredospores broad oval to slightly tapering, yellowish, finely echinulate, 20-30×14-18 μ, average 25×17 μ. Teleutospores globose to broad elliptic or clavate, usually thickened at the apex, dark bay-brown, smooth, on long persistent pedicels; 20-30×17-22 μ, average 25×20 μ. Pedicels pale yellow, 60-110 μ, average 90 μ.

This rust is not recorded by MacAlpine, and is therefore a new record for Australia. It is given in Sydow's Monographia Uredinearum as being fairly widely distributed in Europe. It seems more probable that it is an indigenous rust here which has long been present in our arid districts, but overlooked on account of its inaccessibility, than that it has been introduced. The teleutospores are slightly smaller and darker than those of European specimens, but these differences are so small as not to warrant any separation of the present species from the European one.

Uromyces vesiculosus, Wint. I., II., III., X. On *Zygophyllum ovatum,* Ewart. Koonamore, Aug., 1923, T. G. B. O. (fig. 5, and pl. xxi., fig. 3).

The aecidia of this rust have not been described before. They were found only on the cotyledons and stem-bases of young plants, which were heavily infected, however, with the uredospore and teleutospore stage on the later leaves and stems. As the cotyledons drop off after a little while, this probably explains why the aecidia have not been collected before.

This mode of occurrence of the spore forms suggests that the life history of the fungus is probably as follows:—The teleutospores are the resting or "over-summering" stage, for the host plant grows in arid regions, coming up from seed at the first winter rain. The teleutospores probably germinate at the same time as the seeds of the host plant, infection occurring while the seedlings are still very young. The haploid phase of the fungus initiated thus fructifies as aecidia on the cotyledons or hypocotyl, the resulting aecidiospores serving to infect the later leaves and stems, giving rise there to the diploid phase of the fungus which soon produces uredospores, and later teleutospores to over-summer again. This is an interesting life-history illustrating the tiding over of the unfavourable growing period of the dry summer of arid regions instead of the cold winter, as in most instances studied.

I. **Aecidia** on cotyledons, on hypocotyl or stem just above, or rarely on youngest leaves; pseudoperidia white, cup-shaped, with reflexed, fringed margin; when on stems projecting as almost cylindrical or narrow bell-shaped receptacles $\frac{1}{2}$-$\frac{3}{4}$ mm. long; peridial cells oblong to angular, finely striated, 30×45 μ long; aecidiospores subglobose to angular, orange, 20-26 μ diam.

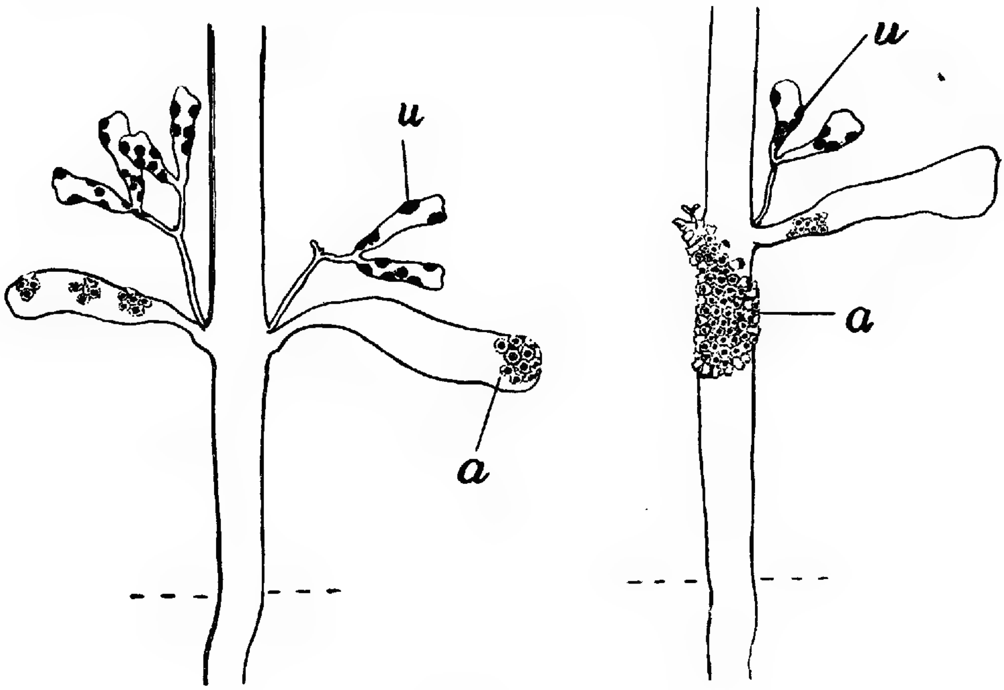


Fig. 5.

Uromyces vesiculosus, Wint. Bases of two seedlings, showing aecidia *(a)* on cotyledons and hypocotyl, and uredosori *(u)* on small axillary shoots. Semi-diagrammatic; drawn from dried material (×2).

The uredospores on the present specimens were considerably longer (28-42 × 15-21 μ, average 35-18 μ) than those whose measurments MacAlpine gives; they were also much less spiny than one is led to expect from his description. As the teleutospores, and the macroscopic appearance of uredosori and teleutosori in the present specimens agree with MacAlpine's description of *Uromyces vesiculosus*, however, the above differences in the uredospores do not seem of sufficient weight to separate the fungus from this species. (McAlp., 1906, p. 103.)

Uromycladium notabile, (Ludw.) McAlp. II. On twigs of *Acacia dealbata,* Link. Aldgate, Jan., 1924, C. H. Beaumont. (McAlp., 1906, p. 108.)

Uromycladium tepperianum, (Sacc.) McAlp. On *Acacia aneura*, F. v. M. Near Broken Hill, N.S. Wales, Aug., 1918, T. G. B. O.; Beltana, Aug., 1921, J. B. Cleland; Koonamore, Aug., 1923, T. G. B. O. (pl. xxii., fig. 1). On *Acacia bynoeana,* Benth. Nunkeri, May, 1921, T. G. B. O. On *Acacia decurrens,* Willd. (cultivated). Aldgate, Mar., 1924, C. H. Beaumont. On *Acacia ligulata,* A. Cunn. Ooldea, Aug., 1922, T. G. B. O. (pl. xxii., fig. 2). On *Acacia linophylla,* W. V. Fitzg. Ooldea, Aug., 1922, T. G. B. O. On *Acacia obliqua,* Cunn. National Park, Sept., 1922, T. G. B. O. On *Acacia penninervis,* Sieb. Cowra Landing, Jan., 1922, T. G. B. O. On *Acacia rigens,* A. Cunn.

Monarto South, May, 1921, J. B. Cleland. On *Acacia tetragonophylla*, F. v. M. Lakes Grave; Umberumberka; Broken Hill District, N.S.W., Aug., 1918, T. G. B. O. Beltana, Aug., 1921, J. B. Cleland; Kingoonya, Aug., 1923, T. G. B. O. (pl. xxii., fig. 3). On *Acacia trineura*, F. v. M. Alawoona, Dec., 1913, J. B. Cleland. On *Acacia verticillata*, Willd. Myponga, Dec., 1923, J. B. Cleland.

Nine of the above are new host species. The list of hosts for this fungus is continually increasing in length, and now comprises about thirty different species of Acacia of the most diverse habit and habitat. On the one hand there are Acacias from moist temperate rain-forests, such as *A. melanoxylon* and *A. decurrens*, while, on the other, are dwarf and spiny forms from the most arid desert regions in Central Australia, for example *A. tetragonophylla*, the "dead-finish bush."

The type of gall produced by the fungus on these different hosts also varies widely. A number of types are well illustrated in MacAlpine's Rusts of Australia; other examples from the above host list are illustrated in the plate accompanying this paper. The knobby galls formed on *Acacia aneura*, the "mulga," frequently cause the gradual death of the shoot beyond the infected part, and a progressive diminution in size of the gall-knobs seems to indicate the slow starvation of the fungus as the shoot dwindles away. On *Acacia tetragonophylla* the reddish-brown sori of the fungus burst out along the small twigs usually without the pronounced gall-formation characteristic of the reaction of most other Acacias; the infected twigs often contrast sharply, on this account, with the silver-grey healthy shoots. At the same time there is often a pronounced development of small witches' brooms.

This great range of infection of *Uromycladium tepperianum* cannot but raise doubts as to the physiological homogeneity of this species. Field observations on the fungus only increase these doubts. For instance, at Ooldea, on the sandhills at the edge of the Nullarbor Plain, *Acacia ligulata* and *Acacia linophylla* are to be found growing together in many places. The Uromycladium galls were found affecting many bushes of *A. ligulata* in a more or less definite, but circumscribed, area near Ooldea Soak. In this area the *A. linophylla* was not affected. In the area where the galls on *A. linophylla* were found the *A. ligulata* was not affected. This cannot but suggest that the fungus affecting one is not cross-inoculable to the other, although morphologically the two fungi are identical in every respect, and referred to the one species, *Uromycladium tepperianum*. Similar observations have frequently been made in the case of other host species growing intermixed; *A. pycnantha* and *A. armata* furnish one example, out of a number that could be cited. It is suggested, therefore, that *Uromycladium tepperianum* may be divisible into a number of "biologic species," each adapted to different species, or groups of species, of *Acacia*. No proof has been advanced for this, but it is hoped to do some experiments on it later on. (McAlp., 1906, p. 111.)

USTILAGINEAE.

Cintractia disticiilydis, McAlp. On *Distichlis spicata*, (L.) Greene (syn. *D. maritima*, Rafin.). Hindmarsh River, Jan., 1923, T. G. B. O. (McAlp., 1910, p. 169.)

Sorosporium piluliformis, (Berk.) McAlp. On *Juncus planifolius*, R. Br. Mylor, Nov., 1922, T. G. B. O. Also on *Juncus caespiticius*, Meyer. Cape Jervis Penins., Jan., 1924, G. S. The latter is a new host species for the fungus, but is very closely allied to *J. planifolius*. Sori ashy-grey from the numbers of colourless sterile cells among the spores. (McAlp., 1910, p. 180.)

TILLETIA FUSCA, Ell. and Ev. On *Festuca myuros,* L. Pinnaroo, Nov., 1923, G. S. MacAlpine records this fungus only on *F. bromoides,* and says: "Although the silver-grass is widely distributed, I have not met with this smut but in one locality (Angustown, Victoria)." It was only found in one patch at Pinnaroo, but is not conspicuous, and might easily be overlooked. (McAlp., 1910, p. 190.)

TOLYPOSPORIUM BURSUM, (Berk.) McAlp. On *Anthistiria ciliata,* L. f. Inman Valley, Jan., 1922, J. B. Cleland. (McAlp., 1910, p. 186.)

TOLYPOSPORIUM JUNCOPHILUM, McAlp. On *Juncus pauciflora,* R. Br. Cape Jervis Penins., Jan., 1924, J. G. Wood. (McAlp., 1910, p. 188.)

USTILAGO BROMIVORA, (Tul.) F. v. M. On *Bromus unioloides,* H. B. and K. Mylor, Nov., 1922, J. B. Cleland. Cresswell Gardens, Adelaide, Nov., 1922, G. S. (McAlp., 1910, p. 150.)

USTILAGO COMBURENS, Ludw. Destroying inflorescence of *Danthonia penicillata,* (Labill.) F. v. M. Near Broken Hill, N.S. Wales, Aug., 1918, T. G. B. O. (McAlp., 1910, p. 153.)

Ustilago hydropiperis, var. *columellifera,* Tul. On *Polygonum lapathifolium,* L. Near Adelaide, June, 1919, W. J. Spafford. (McAlp., 1910, p. 156.)

ASCOMYCETES.

ERYSIPHE CICHORACEARUM, D.C. On *Senecio brachyglossus,* F. v. M. Stephens Creek, near Broken Hill, Aug., 1918, T. G. B. O. (Not listed by MacAlpine.)

OIDIUM sp. On cultivated perennial *Aster.* Blackwood, May, 1919, W. Summers. No perithecia present, but probably referable either to *E. cichoracearum* or to *E. polygoni.*

ERYSIPHE GRAMINIS, D.C. On *Bromus mollis,* L. Park Lands, Adelaide, Dec., 1923, G. S. (McAlp., 1895, No. 1724.)

ERYSIPHE POLYGONI, D.C. On cultivated *Delphinium* sp. Aldgate, Feb., 1924, C. H. Beaumont. (Not listed by MacAlpine.)

PLEOSPORA HERBARUM, (Pers.) Rab. On dead portion of orange leaf, Pinnaroo, Nov., 1923, G. S. Associated with a *Macrosporium* and a *Cladosporium.* The effect on the leaf resembled that described for *Pleospora disruptum,* McAlp. Possibly *P. herbarum* established itself on the dead tissue as a saprophyte, and prevented the fruiting of *Pleospora disruptum.* A very common saprophyte, though not yet "recorded" for South Australia. (McAlp., 1895, No. 1701.)

FUNGI IMPERFECTI.

BOTRYTIS CINEREA, Pers. On *Gomphocarpus arborescens,* R. Br. Causing death of tips of young shoots. Chambers Gully, Aug., 1922, G. S. On cultivated *Crocus* sp. Causing elongated discoloured spots on the leaves. Ambleside, June, 1924, G. S. (McAlp., 1895, No. 1927.)

HETEROSPORIUM GRACILE, (Wallr.) Sacc. Causing spots on the leaves of *Iris germanica,* L. Fullarton, April, 1924, G. S. (Not listed by MacAlpine, but probably wherever *Iris* is grown.)

MACROPHOMA OLEAE, (D.C.) Berl. and Vogl. Common on fallen leaves of *Olea europea,* L., var. *sativa,* D.C. Blackwood, June, 1924, G.S. (Not listed by MacAlpine.)

SEPTORIA APII, Chest. On leaves of *Apium prostratum,* Labill. Noarlunga, May, 1924, G. S. (Not listed by MacAlpine.)

SEPTORIA URTICAE, Desm. and Rob. On *Urtica urens,* L. Horrocks Pass, near Port Augusta, Aug., 1922, G. S. Causing so severe a leaf-spot over a large patch of nettles that the damage was visible at a distance of some yards. (Not listed by MacAlpine.)

PHYCOMYCETES.

Cystopus candidus, Lev. (syn. *Albugo candida,* (Pers.) Rouss.). On *Blennodia canescens,* R. Br. Curnamona, Aug., 1923, T. G. B. O. This is an exceedingly common fungus on Crucifers, but its presence on a native plant in the arid Far North of South Australia, a district with an average rainfall of about 7 inches, is interesting to note. There had only been 4 inches of rain in the two years previous to its collection. (McAlp., 1895, No. 2198.)

Peronospora parasitica, (Pers.) de B. On *Brassica napus,* L. Cottonville, Feb., 1924, per G. Quinn. This is a very common parasite of cabbage seedlings, and has probably existed here for years, though not yet recorded for this State. (Not listed by McAlp., 1895, but recorded for Victoria in 1901 Bulletin, Cabbage and Cauliflower Diseases.)

Synchytrium papillatum, Farl. On *Erodium cygnorum,* Nees. Koonamore, Aug., 1923, T. G. B. O. (Not listed by MacAlpine, but Mr. C. C. Brittlebank informs us that it has been collected on *Erodium moschatum* in Victoria.)

Literature Cited.

Cunningham, G. H.—

1923—The Uredinales, or Rust Fungi, of New Zealand. Trans. N. Z'd. Inst., liv., 619-704, 76 figs., 1 pl.

MacAlpine, D.

1895—Systematic Arrangement of Australian Fungi. Vict. Dept. of Agric.
1906—The Rusts of Australia. Vict. Dept. of Agric.
1910—The Smuts of Australia. Vict. Dept. of Agric.

Osborn, T. G. B.

1915—Some New Records of Fungi for South Australia. Trans. Roy. Soc. S. Austr., xxxix., 352-356.

Osborn, T. G. B., and Geoffrey Samuel.

1922—Some New Records of Fungi for South Australia, Part II., together with a Description of a New Species of *Puccinia.* Trans. Roy. Soc. S. Austr., xlvi., 166-180, 4 figs., 1 pl.

DESCRIPTION OF PLATES XXI. and XXII.

Plate XXI.

Fig. 1. *Uromyces atriplicis,* McAlp. Aecidia covering the under surfaces of the leaves of *Atriplex vesicarium,* Haw. A few teleutosori present.

Fig. 2. *Uromyces phyllodiorum,* (B. and Br.) McAlp. Uredosori surrounding spermogonia on tubercular distorted patches on phyllodes of *Acacia penninervis,* Sieber.

Fig. 3. *Uromyces vesiculosus,* Wint. Aecidia on stem bases, and uredosori on leaves of seedlings of *Zygophyllum ovatum,* Ewart.

Plate XXII.

Fig. 1. *Uromycladium tepperianum,* (Sacc.) McAlp. Galls killing twigs of *Acacia aneura,* F. v. M.

Fig. 2. *Uromycladium tepperianum,* (Sacc.) McAlp. Fusiform galls on stems of *Acacia ligulata,* A. Cunn.

Fig. 3. *Uromycladium tepperianum,* (Sacc.) McAlp. Small witches' broom on *Acacia tetragonophylla,* F. v. M. Sori erupment along smaller twigs.

CHALCIDOIDEA AND PROCTOTRUPOIDEA FROM LORD HOWE AND NORFOLK ISLANDS, WITH DESCRIPTIONS OF NEW GENERA AND SPECIES.

By Alan P. Dodd.

[Read April 10, 1924.]

Through the kindness of the South Australian Museum, the writer has had the opportunity of examining Micro-Hymenoptera collected on Lord Howe and Norfolk Islands by the Museum Entomologist, Mr. A. M. Lea.

The fauna of more or less isolated islands is always interesting, and the present collection bears out this generalisation. The Chalcidoidea show very close relationship to Australian forms, and mainland species are represented; it is rather interesting to find the striking *Metapelma westwoodi*, Girault, in the collection. The occurrence of such peculiar genera as *Cratomus*, Dalman, *Aplatygerrhus*, Girault, and *Hetreulophus*, Girault, calls for remark. The Proctotrupoidea, however, are, on the whole, widely separated from Australian relations; the prevalence of wingless or aborted-winged forms is a typically insular characteristic. *Pseudoceraphron* is a noteworthy discovery, and the species of *Baryconus*, Foerster, and *Hadronotus*, Foerster, are of particular interest.

Superfamily CHALCIDOIDEA.

Family CHALCIDIDAE.

Chalcis, Fabr.

The collection contains one male of a species near *C. victoria*, Girault, and *C. atrata*, Kirby, labelled "Norfolk Island, A. M. Lea."

Stomatoceras, Kirby.

There are two females labelled "Lord Howe Island, A. M. Lea," representing different species and closely allied to the many described forms from Australia. Both are black, the antennae wholly black; one has the legs (except the coxae) red, with a conspicuous black blotch at apical half of posterior femora centrally; the other has the abdomen at its basal half beneath rufous, the legs wholly dark, except the knees and tarsi.

Family AGAONIDAE.

Agaon, Dalman.

A very large series of females; one male, labelled "Reared from Banyan figs, Lord Howe Island, A. M. Lea," would appear to belong here.

Family CALLIMOMIDAE.

Subfamily Idarninae.

Sycoryctes, Mayr.

There is a large series of females, labelled "Reared from Banyan figs, Lord Howe Island, A. M. Lea." I am not aware which *Ficus* is inferred, presumably an introduced tree.[1] Hence it seems safer not to describe the insect, which is wholly metallic-green, the legs wholly yellow.

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(1) *Ficus columnaris*. F. v. M. (A. M. Lea).

TRICHAULUS, Mayr.

Two females, yellow, with dusky-barred abdomens, labelled "Reared from Banyan figs, Lord Howe Island, A. M. Lea," can only be referred to this genus.

Family CLEONYMIDAE.

APLATYGERRHUS, Girault.

This genus was erected to contain a single Tasmanian species, with a peculiar antennal structure. The following species are certainly congeneric, and one resembles the genotype, *A. magnificus,* Girault. I have also three or four undescribed forms from Queensland.

Aplatygerrhus imperialis, n. sp.

♀. Rather dark metallic-green, the head, pronotum, and mesonotum with purple reflections; antennae yellow-brown, the apical joint black; legs yellow-brown, the tarsi paler, the posterior coxae metallic.

Head densely, rather finely reticulate, and with a sparse pubescence; eyes large, pubescent; lateral ocelli one-half closer to the eyes than to the median ocellus; vertex moderately broad and long; viewed from in front the head is much wider than deep; antennal scrobes obsolete; a faint depression above antennal insertion. Antennae inserted much below ventral ends of eyes and well separated, 11-jointed, the club solid; scape rather short; pedicel somewhat longer than its greatest width, and longer than funicle 2; funicle somewhat incrassate; joint 1 very small, transverse, like a ring-joint; 2 much larger but somewhat wider than long, the remainder gradually increasing in size, but all somewhat wider than long; apical funicle joint with a long lateral extension, or spinous process, that embraces the conical club. Thorax normal; sculpture coarser than that of the head and thus closely reticulate-punctate, the whitish pubescence denser; pronotum rather short; parapsidal furrows about half complete from anteriorly; scutellum simple, longer than wide; axillae rather well separated; propodeum smooth, shining, rather long, narrowed posteriorly, with a complete median carina, at base with a short foveate area that is produced at meson for a short distance on either side of the median carina. Forewings ample, normal; hyaline, marked with brown as follows: a cross-dash at rather more than half-way from base to the marginal vein; a rounded blotch just beneath base of marginal vein; a triangular area involving the stigmal vein, its base resting on the anterior costa, its distal margin straight, its apex half-way across wing and connected with a narrow extension of a long narrow stripe along posterior margin, this latter also connected with a rather narrow stripe along the distal margin of the wing; venation dusky; marginal vein rather long, not much shorter than the submarginal; stigmal vein very long and oblique, fully half as long as the marginal, the postmarginal one-half longer than the stigmal. Abdomen no longer than the head and thorax united; depressed above, gently convex beneath; with a very short petiole; segment 2 (first body segment) about as long as 4; 3 very short, transverse; 5 somewhat longer than 4; 6 plainly longer than 5; 7 hardly as long as 5; 8 shorter than 4; 2 and 3 smooth and polished, also posterior half of 4 and 5; 6 and 7, and basal half of 4 and 5, with open scaly sculpture; 2, 4, and 5 with a tuft of white hairs on either side laterally; 6-8 with scattered pubescence. Legs normal; posterior coxae moderately long; anterior and posterior femora feebly swollen, unarmed. Length, 3·50 mm.

One female, labelled "Norfolk Island, A. M. Lea." Type, I. 14545, South Australian Museum, a female on a card.

The wing pattern is very distinct from that of the genotype.

Aplatygerrhus regalis, n. sp.

♀. Dark metallic-green with purplish reflections; antennae yellow-brown, the scape yellow, the club black; legs very pale yellow (almost white), the posterior coxae metallic for two-thirds of their upper surface.

In general structure agreeing with *A. imperialis.* Head closely, densely reticulate, with a punctate tendency. Antennae inserted very slightly below ventral ends of eyes; scape moderately long; pedicel somewhat longer than funicle 2, which is somewhat wider than long; all funicle joints somewhat wider than long, 1 small but not very transverse. Sculpture and pubescence of thorax as in *A. imperialis,* the sculpture of the scutellum not noticeably finer than that of the scutum; propodeum shining, but with faint surface sculpture, broader, and not as long as in *A. imperialis;* in both species there is a foveate sulcus running straight from the spiracle to the posterior margin and along the latter obliquely almost to the median carina, and laterad of the spiracle is a patch of white pubescence. Forewings lightly stained, hyaline beyond the stigmal vein; there is a large pyramidal, smoky-brown cross-stripe appended from the distal half of the stigmal vein, its apex proximad and produced, its distal margin straight. Abdomen a little longer than head and thorax united; apparently sessile; segment 2 as long as 4, 3 very short, 5 twice as long as 4, 6 hardly longer than 5, 7 distinctly shorter than 5, 8 short; 2 and 3, less than posterior half of 4, and posterior margin of 5, smooth and shining; rest of 4 and 5 and 6 (except posterior margin) densely reticulate with a punctate tendency; 7, 8, and posterior margin of 6, with faint sculpture and white pubescence. Posterior coxae with punctate reticulation; posterior femora rather more swollen than in *A. imperialis.* Length, 5·5 mm.

One female, labelled "On *Kentia canterburyana,* Mt. Ledgbird, Lord Howe Island, A. M. Lea." Type, I. 14546, South Australian Museum, the above female on a card.

This species resembles *A. magnificus,* Girault, with cotypes of which it has been compared, in the unifasciate wing, but there are several important differences; *A. magnificus* has dark antennae, deep-coloured legs, the sculpture of the scutellum is very much finer than that of the scutum, and segment 3 of the abdomen is not much shorter than 4, while 6 is much longer than 5.

Family ENCYRTIDAE.

Tribe EUPELMINI.

Eupelmus, Dalman.

Two specimens, labelled "Lord Howe Island, A. M. Lea"; the species is metallic-green, the legs partly metallic, the wings hyaline, the oviposital valves not exserted, and falls in with *E. mawsoni,* Girault, *E. lambi,* Girault, and *E. worcesteri,* Girault.

Anastatus, Motschulsky.

One female, labelled "Lord Howe Island, A. M. Lea"; this is a species in which the oviposital valves are very long. I have the same, or a very similar form, from North Queensland.

Metapelma westwoodi, Girault. Mem. Q'd Mus., iv., 1915, p. 28.

One female, labelled "Lord Howe Island, A. M. Lea." This insect was originally described from Tweed Heads, New South Wales, and the author has a very long series from North Queensland; evidently it is a widely distributed species.

Tribe APHELININI.

APHELINUS, Dalman.

One specimen, labelled "Norfolk Island, A. M. Lea," is black, the abdomen partially yellow, the antennae and legs wholly yellow, and is closely related to *A. dies*, Girault, *A. pax*, Girault, and *A. nox*, Girault, among the many Australian species.

Tribe ECTROMINI.

ANUSIA, Foerster.

The following species falls both in Ashmead's (1904) and Girault's (1915) tables of genera near *Anusia*, and is placed in that segregate for lack of a more suitable position. The multiple genera of the Encyrtidae have been founded very often on such trivial characters, many of which are highly variable, that no one now appears to have a thorough, or even medium, knowledge of their validity.

Anusia viridiflava, n. sp.

♀. Dull orange, washed in places lightly with metallic, the scutum and scutellum either concolorous or mostly metallic; abdomen dusky; meso- and metapleurae fuscous; vertex and upper face bright orange; antennae black, the scape suffused with brown; coxae fuscous, the legs yellow-brown, the femora and tibiae lightly dusky.

Head normal; vertex rather long, from dorsal aspect no more than twice as wide as long, the space between the eyes narrow; frons gently convex; viewed from in front the head is subcircular; eyes large, bare, converging above; ocelli small, the lateral pair close to the eyes, and somewhat closer to each other than to the frontal ocellus; surface densely, finely coriaceous, with a very few, fine, white hairs; mandibles not large, feebly bidentate, the inner tooth broadly truncate. Antennae inserted a little above the clypeus, the scrobes subcircular; scape long, compressed and dilated for its entire length, rather more than twice as long as its greatest width; pedicel normal, somewhat longer than its greatest width; ring joint apparently absent; flagellum subcompressed, subclavate, densely pubescent; funicle joints all much wider than long, plainly shorter than the pedicel; club two-thirds as long as the funicle, obliquely sharply truncate on one margin, the divisions oblique, indistinct. Thorax normal, impunctate, finely shagreened or coriaceous, with a few, fine, scattered hairs; pronotum short, transverse; scutum twice as wide as long; axillae triangular, just meeting at base of scutellum; scutellum sub-triangular, as long as its greatest width; propodeum short, transverse. Forewings somewhat abbreviated, just attaining apex of abdomen; deeply embrowned, the base paler; discal cilia coarse and dense, the marginal cilia very short; venation thick and distinct; submarginal vein joining the costa at almost half-wing length, the marginal vein linear, fully as long as the stigmal, which is almost horizontal and close to the wing margin, the postmarginal hardly developed; an incomplete, oblique, hairless line is present. Legs normal; intermediate tibial spur short and stout. Abdomen short, depressed, triangular. Length, 0·90 mm.

Described from one female, labelled "Norfolk Island, A. M. Lea" (type), and "reared from wood, Lord Howe Island, A. M. Lea" (cotype). Type, I. 14551, South Australian Museum, a female on a card.

In the type, the scutellum is wholly metallic, the scutum washed with metallic; in the cotype, the scutellum is orange, the scutum lightly washed with metallic.

Family PERILAMPIDAE.

Austroperilampus, n. gen.

♀. Head, viewed from above, transverse, broad, the occiput declivous and straight; viewed from the side, the outline of the frons is almost straight; viewed from in front, the head is wider than long, quadrangular, the clypeus broadly truncate; eyes moderately large, bare; ocelli large, the lateral pair closer to the median one than to the eyes; antennal scrobes rather deep, distinct; mandibles very large, broad, deeply bidentate. Antennae inserted in the middle of the face, and slightly above a line drawn across ventral ends of eyes; 13-jointed, with one large ring joint, the club 3-jointed; funicle joints very slightly increasing in width, all a little wider than long; club not enlarged. Thorax stout, from lateral aspect its dorsal outline convex; pronotum large, not as long as the scutum and much wider than long; scutum large, the parapsidal furrows very deep, complete, coarsely foveate; posterior line of scutum not foveate; axillae large, meeting at inner angles, separated from the scutellum by a coarsely foveate groove; scutellum large, convex, no longer than its greatest width, its posterior margin foveate; postscutellum short, raised at meson, sulcate for the rest; propodeum broad, conspicuous, but much shorter than the scutellum, coarsely sculptured, at meson with a median carina that branches at half its length; spiracle prominent, the spiracular sulci represented by a line of foveae. Forewings very large and broad; naked beneath the submarginal vein (*i.e.*, for almost half), the apical half with fine, rather sparse discal cilia; submarginal vein distant from the costa which it joins at almost half-wing length, several times as long as the linear marginal vein; stigmal vein long, two-thirds as long as the marginal, its apex foot-shaped; postmarginal vein hardly developed. Hindwings large, with a long costal vein. Femora bearing long fine setae; tibiae and tarsi densely setose or spiny; posterior coxae long, almost as long as their femora, which are rather stout, their tibiae and tarsi slender, the tibiae with two unequal apical spurs. Abdomen short and stout, not more than one-half longer than its greatest width; sessile; rising abruptly from base; segment 2 (first body segment) longest, occupying one-third of surface; 5 next longest; 3 shorter than 4; 7 very short and abruptly truncate, the ovipositor valves not exserted. Sculpture of body smooth to finely lineolate, with a few punctures.

This genus belongs in that anomalous group of Perilampine genera, which would appear to have their headquarters in Australia, and which are apparently all true gall-makers. In Girault's table of genera (1915) it runs to *Perilampus*, Latrielle, but is not at all related to that genus. It appears closely related to *Trichilogaster*, Mayr., but differs in the non-development of the postmarginal vein, and in having but one ring joint. Genotype, *A. leai*, described herewith.

Austroperilampus leai, n. sp.

♀. Head orange-yellow, a line across the ocelli, and the occiput more or less dusky, eyes and ocelli black; thorax black, a large patch involving almost all of pronotum laterally, and a narrow line across its posterior margin, tegulae, and meson of postscutellum, yellow; abdomen black, brownish-yellow ventrad, also all of second segment; antennae black, the scape and pedicel yellow; coxae fuscous, femora dusky-brown except at base and apex, the legs otherwise clear yellow; mandibles black.

Vertex of head finely transversely striate or lineolate behind the ocelli, and continued laterally for some distance behind the eyes; in front of ocelli longitudinally lineolate or finely striate on either side of antennal scrobes; lower face and cheeks smooth, except for a few, soft, long hairs above the mouth.

Pronotum finely transversely lineolate, smooth posteriorly, with scattered, long, fine, whitish setae; scutum smooth, against and inside the parapsidal furrows with a row of obscure punctures bearing long setae, the surface with a very few, setigerous, small punctures, and showing very faintly, subobsoletely lineolate, this sculpture more distinct anteriorly on the parapsides and adjacent area of the median lobe; axillae smooth, also the scutellum, except for a few, small, setigerous punctures laterally; propodeum inside the spiracle with numerous irregular carinae, outside the spiracle densely rugo-punctate; mesopleurae strongly longitudinally (anterior-posteriorly) striate or lineolate; metapleurae coarsely rugo-punctate. Wings hyaline, the forewings with an obscure brown cross-stripe beneath the end of the submarginal vein; venation conspicuous, yellow-brown. Abdomen smooth and shining, the apical segments finely transversely striate. Length, 3·5 mm.

Two females, labelled "Lord Howe Island, A. M. Lea." Type, I. 14552, South Australian Museum, a female, card mounted.

Family MISCOGASTERIDAE.

Tribe LELAPINI.

Lelaps truncatipennis, n. sp.

♀. Dull black; prothorax and adjacent margin of the scutum, posterior portion of the scutellum, axillae, neck of propodeum, petiole of abdomen, and a broad obscure band at half length of the abdomen, deep dull red; face showing reddish; antennae fuscous, the scape yellow, the pedicel suffused yellow, the apical two club joints yellow; coxae pale yellow or whitish, the femora brown, the tibiae deep yellow, the tarsi paler.

Head broad, the vertex rather thin, the occiput straight and immargined; viewed from in front as wide as deep, the frons depressed for its entire length; surface with fine scaly sculpture, which is coarser on the vertex; eyes large, bare; ocelli close together; vertex with six long black bristles, of which two are behind the ocelli and two are on either side against the eyes; at least one mandible tridentate. Antennae inserted below middle of face and slightly above a line drawn across ventral end of eyes; with seven funicle joints and a 3-jointed club (a narrow ring joint may be present, but this was not determined); scape long and slender; pedicel slender, twice as long as its greatest width; funicle 1 somewhat shorter than the pedicel and somewhat longer than wide, 7 plainly wider than long; club longer than the two preceding joints united, conical, its joints 1 and 2 of equal length. Thorax normal; pronotum short, with two black bristles at meson, and one at either latero-posterior angle; scutum with a scaly surface sculpture and recumbent pale pubescence, smooth and polished posteriorly (except laterally), the parapsidal furrows four-fifths complete from anterior margin and well separated; a single black bristle is situated against and inside of each parapsidal furrow at half its length; axillae widely separated; scutellum with a finely foveate transverse groove just beyond the middle, in front of the groove with fine surface sculpture and pubescence, smooth for the rest, with a single black bristle on either side of meson just out from base, and one on either side laterally against and proximad of the transverse groove; propodeum rather long, with a short neck, with complete median and lateral carinae, and with a complete cross-carina at about half its length; mesopleurae large, swollen, smooth, and shining. Forewings abnormal, narrow; very short, extending not far beyond base of abdomen; abruptly truncate at apex; suffused brownish, the infuscation not uniform; discal cilia present on less than distal third; with a costal vein, and no others; arising from the vein are twelve or more stiff black setae or bristles. Abdomen with a short, transverse, rugose

petiole; body of abdomen faintly convex above, deeply convex beneath; no longer than the head and thorax united, pointed conic-ovate; segment 2 (first body segment) occupying slightly more than one-half of surface, 3-6 short, transverse, 7 or apical segment as long as 3-6 combined, the ovipositar valves slightly exserted; abdomen smooth and shining, with fine scattered setae on segment 7. Legs normal, the posterior tibiae with two very short apical spurs. Length, 3 mm.

Described from one female, labelled "Norfolk Island, A. M. Lea." Type, I. 14553, South Australian Museum.

Neapterolelaps leai, n. sp.

♀. Orange-yellow, the posterior fourth or more of the scutum jet black, the abdomen with two, broad, dusky cross-stripes on its posterior half; legs, including the coxae, pale silvery-yellow, the tibiae and tarsi faintly dusky, the posterior femora dusky, their tibiae pale; antennal scape yellow, the pedicel dusky, the flagellum black (both antennae are incomplete); eyes and ocelli black.

Head normal; vertex moderately long, the occipital margin straight; viewed from in front circular; antennal scrobes extending half-way to median ocellus; surface with fine, close, scaly sculpture and no pubescence; eyes large, reaching to the occiput and extending for two-thirds length of face, bare; ocelli wide apart, in a sub-equilateral triangle, the lateral pair separated from the eyes by somewhat more than their own diameter. Antennae inserted on a level with ventral ends of sides; scape moderately long and slender; pedicel slender, more than twice as long as its greatest width; ring joint small but distinct; funicle 1 somewhat shorter than the pedicel, 4 quadrate (the remaining joints of the antennae are missing). Thorax normal; pronotum rather short, finely alutaceous, and with recumbent pubescence like the scutum; scutum as long as its greatest width, its posterior margin gently convex, the black posterior portion (a fourth or more) without pubescence, finely transversely lineolate and contrasting with the anterior three-fourths; anterior margin of the scutum with a row of fine, erect, black setae; parapsidal furrows forming a Y, three-fourths complete from anteriorly and just attaining the black portion of the scutum, subjoined and sharply curved for their posterior third; axillae rather small, slightly advanced, almost meeting medially; scutellum semicircular, twice as wide as its greatest length, almost smooth, on either side posteriorly with a short erect bristle; propodeum not very long, without carinae, finely irregularly longitudinally rugose. Wings aborted, reduced to short flaps which terminate in a long black bristle. Abdomen no longer than the head and thorax united; pointed conic-ovate; straight beneath, gently convex above; with a very short, stout, transverse petiole; segment 2 occupying a little more than half of surface, smooth but with sparse recumbent pubescence, 3-6 short and transverse, 7 (apical segment) conical and as long as the three preceding segments united, the ovipositral valves hardly exserted. Posterior femora plainly swollen; posterior tibiae with two long apical spurs, one of which is exceedingly long, as long as the basal two tarsal joints. Length, 3·25 mm.

Described from one female, labelled "Lord Howe Island, A. M. Lea." Type, I. 14554, South Australian Museum.

This species appears to agree with *Neapterolelaps*, Girault, of which only the genotype, *N. lodgei*, Girault, from Queensland, was formerly known; however, Girault's description gives the parapsidal furrows absent; the non-carinate propodeum, aborted wings, and long posterior tibial spurs are distinguishing characters for the genus.

Family PTEROMALIDAE.

Tribe ASAPHINI.

Ophelosia leai, n. sp.

♀. Dull metallic-green, the pronotum washed with brown, the propodeum, sides, and venter of thorax very dark reddish-brown lightly washed with metallic (there is no trace of metallic colouring on the propodeum); abdomen washed with brown; legs wholly dusky yellow-brown, the tarsi clear yellow; antennae fuscous, the scape yellow.

Head transverse, somewhat wider than the thorax, the occiput margined; viewed from in front much wider than deep, the lower half of the face circularly depressed; frons broad; vertex and upper frons finely transversely lineolate, and with a few very fine setae; eyes large, bare; ocelli wide apart, the lateral pair twice as far from the median ocellus as from the eyes; mandibles tridentate, the teeth acute. Antennae inserted against the mouth; 8-jointed, the funicle 5-jointed, the club solid; scape slender, moderately short, as long as the next five joints combined; pedicel not much longer than its greatest width; funicle 1 small, transverse, like a ring joint, 2-5 slightly clavate, all distinctly wider than long; club solid, broadly rounded at apex, as long as the three preceding joints united. Pronotum stout, transverse, finely transversely lineolate and with fine scattered pubescence like the scutum; scutum transverse, twice as wide as long, the parapsidal furrows well marked and complete; axillae widely separated, almost smooth; scutellum longer than its greatest width, with fine sub-transverse impressed reticulation, abruptly smooth posteriorly but without a cross-suture, with a long seta at each anterior-lateral and posterior-lateral angles; propodeum long, somewhat produced, finely irregularly rugose, at base with a pair of fine median carinae that diverge in the form of a V. Forewings moderately long and broad; hyaline, but there is a linear fuscous cross-stripe at the bend of the submarginal vein, involving a number of stiff black discal cilia or bristles, and a large quadrangular blotch appended from the stigmal vein and narrowed at its base; proximal fourth of wing (as far as the cross-stripe) naked, and there is also a naked oblique area beneath all of the marginal vein with its base resting on the first cross-stripe, the remainder of the wing densely finely ciliate; venation yellow-brown, bearing stiff bristles; marginal vein rather more than twice as long as the submarginal, more than twice as long as the stigmal vein, which is long and slender, the postmarginal vein hardly as long as the stigmal. Petiole of abdomen short and stout, appended beneath the extremity of the propodeum; abdomen flat above, faintly convex beneath; smooth; on either side of the base is soft whitish pubescence; basal segment occupying three-fourths of surface. Legs normal; anterior and posterior femora gently swollen; posterior tibial spur long and slender, not much shorter than the basal tarsal joint. Length, 1·5 mm.

Described from two females, labelled "Lord Howe Island, A. M. Lea," and one female, labelled "Norfolk Island." Type, I. 14555, South Australian Museum.

Of the various species of the genus, *O. viridithorax*, Girault, is the only one with much metallic on the thorax, but the original description of that species is too short for the necessary comparison to be made.

TOMOCERA CALIFORNICA, Howard.

There are two females, labelled "Norfolk Island, A. M. Lea." This common Coccid parasite is widely distributed, occurring in California, Hawaii, and Australia. Girault has described two species, *T. glabriventris* and *T. flaviceps*, the former from various localities in Queensland and New South Wales, the latter

from the Northern Territory; I doubt if *T. flaviceps* is distinct from *T. glabriventris,* which, again, appears identical with *T. californica.* I am not aware what reasons Girault has assigned for transferring the genus to the Cleonymidae; to me it bears a close relationship to *Ophelosia,* and I see no reason for altering its usually recognized position.

Tribe CRATOMINI.

This small tribe, containing only two genera, has not previously been recognised in the Australian fauna, and my knowledge of the group has been obtained from Ashmead's Monograph, where it is treated as a tribe in the Subfamily Sphegigasterinae. In the present collection are two species which, together with four others in my own collection from North Queensland, have caused me great trouble to determine satisfactorily. In general appearance and structure these six species closely resemble the members of the Spalanginae, especially *Spalangia* and *Cerocephala;* the similarity is most marked. In fact, but for the somewhat different shape of the head and the position of insertion of the antennae, one would certainly refer them there; but these two differences prevent that solution to the question of their rightful location. However, I have very little doubt but that I have correctly placed them; assuming this to be so, then it seems that the *Cratomini* is much more nearly related to the Spalanginae than to the Sphegigasterinae, and should be treated as a tribe in the former subfamily.

One anomality remains to be explained. *These species have two apical spurs on the posterior tibiae,* There can be no doubt on this point. I have examined several sets of tibiae, representing at least three species, and in all, two slender apical spurs were made out. But whether these are single or double is the sole distinguishing factor between the families Pteromalidae and Miscogasteridae, the former possessing one, the latter two such spurs. However, the group of species discussed here has no affinities with any tribe in the Miscogasteridae; it is obviously closely related to the Spalanginae, and to remove it thence on account of this trivial character is not warranted. This distinguishing point between the two families is purely artificial, and, in the writer's opinion, untenable.

CRATOMUS, Dalman.

So that the genus, in the sense understood here, can readily be recognised, the characters of this group of species are given below.

♀. Head subglobose; frons convex, produced more or less between the eyes, and divided by two, deep, sharply-defined, antennal furrows, so as to appear tricornute; vertex broad, long; temples broad; eyes not large; ocelli close together, the lateral pair much nearer the median ocellus than to the eye margins. Antennae inserted on a level with ventral ends of eyes and about in middle of face; 9-jointed (counting the club as solid); scape long, somewhat curved for its entire length; pedicel short; no ring joint; flagellum subclavate; club conical, the divisions subobsolete. Thorax long; pronotum prominent, long, as long as wide, somewhat narrower than the scutum; scutum no longer than the pronotum, wider than long, the parapsidal furrows deep, complete, foveate, the lobes convex; scutellum large, somewhat longer than its greatest width, simple; axillae meeting inwardly, separated from the scutellum by a coarsely foveate groove; propodeum rather long, narrowed apically, not declivous, with complete lateral carinae, inside these with a network of interlacing carinae, sometimes showing an obscure median carina. Forewings normal, ample, maculate; discal ciliae absent beneath submarginal vein, the distal three-fifths of wing with scattered cilia; marginal cilia absent on anterior margin and posterior margin for two-thirds its length, the rest with a dense short or long fringe of hairs;

submarginal vein distinct from the costa; the marginal vein long but never as long as the submarginal, several times as long as either the postmarginal or stigmal, which are about subequal, the latter curved; venation with stiff setae for its entire length. Abdominal petiole variable, transverse or slender, but never much longer than the posterior coxae; body of abdomen almost straight above, convex below, blunt posteriorly, the oviposital valves exserted for a length never more than that of the abdomen; segment 2 (first body segment) as long as 4, longest, the others rather short; apical segment and the oviposital valves bear a few fine setae of great length, besides ordinary setae. Legs normal; posterior coxae rather long; anterior and posterior femora usually somewhat swollen; posterior tibiae with two slender, unequal, apical spurs; tarsi 5-jointed.

♂. At once differing from the female in having the petiole of the abdomen very long, much longer than the hind coxae, and nearly as long as the short body of the abdomen; segment 2 longest but not greatly longer than 3, the rest gradually decreasing in length. Antennae 11-jointed, scape, pedicel, one large ring joint, seven funicle joints, and an apparently solid club.

All the species have been collected on wood, and are probably parasitic on coleopterous larvae.

Cratomus insularis, n. sp.

♀. Black, the abdominal petiole and the pronotum anteriorly reddish; abdomen faintly suffused brownish; oviposital valves pale yellow for basal third; legs fuscous, the tarsi yellow, the posterior coxae silvery-white except at base above; antennal scape and pedicel black, the flagellum deep red.

Head distinctly produced between the eyes; vertex and upper frons smooth, except for scattered minute punctures bearing short fine setae; finely longitudinally striate on either side of frontal prominence; lower face, with coarser denser striae converging around mouth, and also with larger punctures bearing longer setae; cheeks with moderate-sized punctures. Funicle 1 one-half longer than its greatest width, slightly longer and narrower than the pedicel, the flagellum clavate, funicle 6 thus much wider than long; club as long as preceding three joints combined. Thorax smooth and shining, except for a very few minute punctures, the pronotum somewhat longer than the scutum. Forewings subhyaline, with two fuscous bands, the first and narrower one at the junction of the submarginal and marginal veins, the second and broader (but longer than wide) one with its apical margin touching the apex of the stigmal vein; marginal cilia not long; venation fuscous; marginal vein almost as long as the submarginal. Abdomen smooth, except for faint wrinkles on basal half of segments 5-7; segment 2 with its posterior margin rather sharply incised; exserted portion of oviposital valves equal to two-thirds length of body of abdomen. Legs rather densely pubescent; posterior and anterior femora a little swollen. Length, 2·75 mm. (excluding ovipositor).

Described from four females, labelled "Rotten wood, Lord Howe Island, A. M. Lea." Type, I. 14557, South Australian Museum, a female on a card. One of the undescribed North Queensland species is very similar to the above.

Cratomus viridinotum, n. sp.

♀. Head yellow-brown, the vertex lightly washed with metallic; thorax laterally and ventrally fuscous, above metallic-green, the pronotum almost wholly yellow, the propodeum fuscous, its apex pale-yellow; abdomen brown-black, its petiole pale yellowish; oviposital valves fuscous; legs, including the coxae, bright yellow, the posterior coxae whitish; antennae yellow, the apical funicle joint and the club fuscous.

Head viewed from in front subcircular; frons gently convex from eye to eye, the antennal scrobes well defined and separated by a thin sharp carina; vertex and frons smooth, except for scattered minute punctures, the face below the eyes finely longitudinally striate; eyes not large; ocelli close together and not very widely separated from the eyes. Antennae inserted on a level with ventral end of eyes; scape as long as next four joints combined; pedicel not much longer than its greatest width; flagellum subclavate; funicle 1 hardly as long as pedicel, 6 somewhat wider than long; club almost as long as preceding three joints combined, its divisions subobsolete. Thorax normal, smooth and shining, with a few minute punctures, the parapsidal furrows and the groove between the axillae and scutellum finely foveate; pronotum subquadrate, as long as the scutum; propodeum finely, transversely, rugose-carinate, the lateral and median carinae obscure. Forewings hyaline, with a broad pale-fuscous band from apical half of marginal and all of stigmal vein; scattered discal cilia of apical three-fifths of wing very fine; marginal cilia moderately short; submarginal and marginal veins about subequal, the stigmal vein short and curved, the postmarginal somewhat shorter than the stigmal; venation yellowish. Abdominal petiole short and transverse; body of abdomen flat above, convex beneath, the ovipositor valves exserted for a length equal to one-third that of abdomen; segment 2 occupying one-third of surface, somewhat longer than 4, 3 short. Legs normal, the anterior and posterior femora not noticeably swollen. Length, 1·60 mm.

Described from one female, labelled "Lord Howe Island, A. M. Lea." Type, I. 14558, South Australian Museum, a female on a card, appendages on a slide.

A rather slender, delicate species, very different from *C. insularis* in appearance, but very similar in structure. The wings bear a marked resemblance to those of the Spalangine genus *Cerocephala*, Westwood.

Tribe SPHEGIGASTERINI.

Polycystomyia benefica, Dodd.

The collection contains three females, labelled "Norfolk Island, A. M. Lea," which should probably be referred to this species, which has been recorded as a parasite of the bean-fly, *Agromyza phaseoli*, Coq.; one specimen has the posterior coxae metallic, the first two pairs of coxae brown, the legs deep yellow; the other two have all the coxae yellow, the legs lighter yellow.

The genus *Polycystomyia*, Dodd, appears identical with *Pseudosphegigasterus*, Girault, the only distinction being that the antennal club is stated to be solid in the latter, 3-jointed in the former; this hardly seems a valid generic character.

Tribe SPALANGINI.

Cerocephala, Westwood.

Three females, labelled "Lord Howe Island, A. M. Lea," are dull brown and fuscous. The species of the genus are parasitic on *Calandra* and other grain weevils, and are cosmopolitan. There is little doubt but that *Spalangiomorpha*, Girault, is identical with *Cerocephala*, and the type species, *S. fasciatipennis*, Girault, is possibly a well-known, widely-spread insect.

Tribe ROPTROCERINI.

Pseudanogmus fasciipennis, Dodd.

Several females of this or a very closely-allied species, labelled "Lord Howe Island, A. M. Lea," and "Norfolk Island, A. M. Lea," are much smaller than the typical form, measuring 1·25 mm., and the sooty blotches on the wing are much less pronounced. The type specimen was collected in North Queensland.

Family EULOPHIDAE.

Tribe OPHELININI.

Sympiesomorpha norfolcensis, n. sp.

♀. Bright metallic-green; legs wholly golden-yellow, but the posterior coxae are almost wholly metallic; antennae black, the basal half of the scape yellow.

Head normal; vertex not thin, with fine scaly sculpture; frons depressed, the antennae inserted wide apart and on a level with the ventral ends of the eyes; eyes normal, feebly pubescent; frons smooth. Antennae 10-jointed, with one ring, four funicle, and three club joints; scape long and slender; pedicel not much longer than its greatest width; funicle loosely jointed, with long scattered hairs; funicle 1 much larger than the pedicel and two-thirds longer than its greatest width, 2-4 subquadrate; club not enlarged, not much longer than its greatest width, joint 1 longer than 2 and 3 combined, 3 minute, with a terminal nipple or short spur. Thorax normal; pronotum transverse but distinct, with raised scaly sculpture and a few long setae, its posterior margin almost smooth; scutum with rather coarse raised reticulation, the parapsides finely scaly, the parapsidal furrows well marked and complete; the median lobe of the scutum bears two long fine setae on either side at posterior half against the parapsidal furrows; there is one such setae on each parapside; axillae well advanced, with faint sculpture; scutellum rather long, with rather coarse scaly sculpture, on either side with a well-marked lateral groove that curves round but does not join at the posterior margin; postscutellum prominent, finely scaly; propodeum moderately long, without a neck, almost smooth, with a fine paired median carina, and distinct spiracular sulci. Forewings long; broad; hyaline; discal ciliation normal, the proximal third of the wing (as far as the marginal vein) naked, but there is a short cross-line of cilia at the bend of the submarginal vein that joins a median line of cilia which is continued to reach the posterior margin at half its length; venation well marked; submarginal vein not distinctly broken, as long as the marginal, which is a little longer than the postmarginal; stigmal vein long, slender, about one-third as long as the marginal. Abdomen normal; pointed conic-ovate. Legs slender; posterior tibiae with two short apical spurs; tarsi 4-jointed. Length, 1·8 mm.

Described from one female, labelled "Norfolk Island, A. M. Lea." Type, I. 14563, South Australian Museum.

This species agrees very well with the generic characters, even to sculpture, of *Alophomorpha*, Girault, which Girault originally described in the Ophelinini, and subsequently transferred to the Eulophini, in which tribe the parapsidal furrows are incomplete. Of the other Australian genera of the Ophelinini, it might fall in *Alophomorphella*, Girault, but at least the species is distinct from mainland forms.

Tribe TETRASTICHINI.

TETRASTICHUS, Haliday.

The collection contains a series of a dark-green species of this genus, *sensulatu,* labelled "Lord Howe Island, A. M. Lea."

Tribe HETREULOPHINI.

Hetreulophus clavicornis, n. sp.

♀. Bright metallic-green and blue, the abdomen darker; coxae concolorous, the femora fuscous, the anterior and intermediate tibiae yellow lightly washed with fuscous, the posterior tibiae fuscous with a white band at half their length, which is as long as the apical fuscous portion, tarsi yellow; antennae wholly dark.

Head normal, transverse, no wider than the thorax, with fine impressed reticulation; viewed from in front plainly wider than deep, the frons broad; mandibles tridentate, the teeth acute. Antennae inserted a little above the mouth, 11-jointed, the club solid; scape broad and compressed, hardly more than twice as long as its greatest width, but as long as the next seven joints combined; pedicel stout, not much longer than its greatest width; funicle 8-jointed, the first four joints minute and transverse, like ring joints, 1-6 clavate, 6-8 subequal, each fully twice as wide as long; club bluntly rounded, as long as the three preceding joints united, and more than one-half as long as the scape; antennal joints bearing stiff hairs. Thorax normal; pronotum short; scutum with raised polygonal reticulation, the parapsidal furrows indicated anteriorly; axillae smooth, well advanced; scutellum shining, but showing faint subobsolete reticulation, with a concave line of fine foveae on either side, and a line of similar foveae just before the apex; postscutellum separated from the scutellum by a fine line, smooth, semicircular, and very conspicuous for the family; propodeum shining, moderately long but without a neck, with a median carina and no others. Forewings long and broad; beneath the submarginal vein hyaline and without discal cilia, except for a narrow, brown, median, longitudinal line following a similar line of discal cilia, and terminating at a narrow brown cross-stripe from the bend of the submarginal vein (these two stripes represent the median and basal veins); remainder of the wing uniformly densely ciliated; lightly embrowned, except for two narrow hyaline splashes forming an interrupted line across the wing from the base of the stigmal vein, and an irregular, convex, narrow stripe across the wing from the apex of the stigmal vein; venation normal; submarginal vein not distinctly broken; marginal vein as long as the submarginal; stigmal vein long and curved, the postmarginal twice as long as the stigmal and fully one-half as long as the marginal. Abdomen slender, upturned at apex, the oviposital valves exserted for a length equal to one-fifth that of the abdomen. Legs normal, the tarsi 5-jointed. Length, 1·45 mm.

Described from two females, labelled "Lord Howe Island, A. M. Lea." Type, I. 14565, South Australian Museum.

This species agrees very well with Girault's diagnosis of the genus, except for the thickened antennal scape and shorter flagellar joints. Girault described the antennae with one ring and seven funicle joints, but in the species before me, as all the joints bear stiff pubescence, it would hardly be correct to consider any of the minute funicle joints as ring joints. The postscutellum is unusually prominent, and the suture between it and the scutellum very delicate; but there is a distinct groove across the scutellum just before this suture. The genus appears to me to be typically Eulophine, despite the 5-jointed tarsi.

Family MYMARIDAE.

Gonatocerus, Nees.

A single specimen of a small, obscure species, black, the legs and antennae wholly dusky, is labelled "Lord Howe Island, A. M. Lea."

Superfamily PROCTOTRUPOIDEA.

Family CERAPHRONIDAE.

Ceraphron, Jurine.

The collection contains a male, labelled "Norfolk Island, A. M. Lea," and also a female labelled "Mt. Gower, Lord Howe Island, A. M. Lea"; the latter is closely related to *C. flavicoxa*, Dodd, and other Australian species.

Pseudoceraphron, n. sp.

♀. Head, viewed from above, large, transverse, much wider than the thorax, which it encircles as far as the posterior margin of the scutum; vertex moderately long, the occiput margined and concave; viewed from in front, the head is triangular, somewhat wider than deep; eyes large, bare, extending to the occipital margin and half-way to the mouth; ocelli minute, wide apart. the lateral pair closer to the median ocellus than to the eyes; mandibles either bi- or tridentate. Antennae inserted somewhat above the mouth but well below a line drawn across the base of the eyes; 11-jointed; scape moderately short, but more than twice as long as the pedicel, which is about twice as long as its greatest width; flagellar joints 1-7 minute, transverse, gradually enlarging, 8 much larger but twice as wide as long, the large club as long as the preceding eight joints combined, conical, twice as long as its greatest width. Thorax, from lateral aspect, almost hidden by the head; viewed from above, twice as wide as long; pronotum not visible from above; scutum very transverse, several times as wide as long, with complete parapsidal furrows, and a complete median groove; scutellum transverse; median segment very short and transverse. Wings entirely wanting. Abdomen somewhat wider than the thorax; twice as long as the head and thorax united, but hardly more than twice as long as its greatest width; from lateral aspect, gently convex above, so deeply convex beneath as to be nearly as high as long; rounded on the sides and non-carinate; broadly sessile at base; basal segment occupying almost all of surface, but the subpointed apex is composed of several transverse segments. Legs normal; femora and tibiae normally slender, those of anterior pair of legs somewhat swollen; apical spur of anterior tibiae long, curved, simple, tarsi short; posterior tarsi two-thirds as long as their tibiae, their basal joint not twice as long as the second and shorter than the enlarged apical joint.

This is a quite distinct and most interesting genus; it falls near *Conostigmoides*, Dodd (*Eumegaspilus*, Ashmead, 1893, *nec* 1888), but the much shortened thorax with its transverse sclerites, the broadly sessile abdomen, and the very small flagellar joints of the antennae, readily distinguish it. In general appearance the genotype bears a striking resemblance to members of the Scelionid genus *Baeus*, Haliday, which is heightened by the short compact flagellum and the much enlarged apical joint of the antennae. Type, the following species.

Pseudoceraphron pulex, n. sp.

♀. Yellow-brown, the abdomen somewhat dusky; legs wholly yellow; antennal scape, less than apical half of pedicel, and the distal funicle joint silvery-white; rest of pedicel, and the first seven funicle joints, black, the club fuscous; eyes and ocelli black.

Body without pubescence. Head smooth and polished; scutum and scutellum finely, irregularly, transversely lineolate; abdomen smooth but showing fine transverse lineolation. Length, ·9 mm.

Described from one female, labelled "Fallen leaves, Lord Howe Island. A. M. Lea." Type, I. 14569, South Australian Museum.

Family SCELIONIDAE.

Trimorus, Foerster.

Two species are represented in the collection; one is of especial interest, in that it is the first wingless form of the genus to be discovered in the Australian region; the second is closely allied to mainland species.

Trimorus norfolcensis, n. sp.

♀. Dull black; legs, including the coxae, golden-yellow; antennal scape and pedicel yellow, the rest black.

Head normal; viewed from above, twice as wide as long, the vertex not thin; viewed from in front, plainly wider than deep; eyes large, with a few short setae; ocelli very small, wide apart, the lateral pair separated from the eyes by twice their own diameter; vertex and frons smooth and polished, with a few scattered fine setae; toward occiput with dense surface sculpture; around mouth with converging striae; frons not depressed, but there is a faint median carina running from antennal insertion for some distance. Antennae normal, 12-jointed; scape moderately long and slender; pedicel one-half longer than its greatest width; funicle 1 slightly longer than pedicel, 2 a little shorter than 1, 3 as wide as long, 4 short; club compact, 6-jointed, the joints transverse. Thorax not much longer than its greatest width; scutum much wider than long, broadly rounded anteriorly, with dense fine surface sculpture and numerous pin-punctures bearing fine setae; parapsidal furrows complete, wide apart; scutellum semicircular, smooth except for scattered, setigerous pin-punctures; postscutellum produced at meson in the form of a stout acute tooth; median segment hidden at meson, its caudo-lateral angles subacute. Wings aborted; short narrow flaps that do not reach beyond the posterior margin of the thorax. Abdomen much wider than the thorax, somewhat narrowed at base, blunt posteriorly; segment 1 very short, transverse; 3 almost as long as wide, somewhat longer than 1 and 2 or 4-6 united; 1 and 2 striate, 3-6 with fine, polygonal, surface sculpture and fine pubescence. Legs slender; posterior tarsi no longer than their tibiae, their basal joint as long as 2-4 united. Length, 1·3 mm.

Described from eleven females, labelled "Rotting leaves, Norfolk Island, A. M. Lea." Type, I. 14570, South Australian Museum.

Trimorus leai, n. sp.

♀. Head and thorax black, the abdomen dark brown, its basal segment bright yellow; antennae black, the scape and pedicel yellow, lightly washed with dusky; legs, including the coxae, yellow, lightly washed with dusky.

Head normal; no wider than the thorax, the vertex thin, the frons broad; viewed from in front, somewhat wider than deep; surface smooth and polished; eyes moderately large, bare; ocelli small, the lateral pair somewhat closer to the median ocellus than to the eyes. Antennae 12-jointed; scape long and slender, as long as next seven joints combined; pedicel one-half longer than its greatest width; funicle 1 as long and as wide as pedicel, 2 a little shorter, 3 as wide as long, 4 wider than long; club compact, 6-jointed, the joints much wider than long. Thorax slightly longer than its greatest width; scutum with numerous fine punctures, the parapsidal furrows wide apart, distinct and complete; scutellum semicircular, smooth except for the foveate posterior margin; postscutellum with a short tooth at meson; median segment short, its caudo-lateral angles toothed. Forewings extending well beyond apex of abdomen; moderately narrow (three and a half times as long as the greatest width), the apex rounded; longest marginal cilia equal to one-fourth greatest wing width; discal cilia coarse and dense; venation fuscous, terminating at half-wing length; marginal vein shorter than the submarginal; stigmal vein short, oblique, knobbed at apex; forewings faintly tinted. Abdomen broadly oval, narrowed at base, rounded posteriorly; wider than the thorax; no longer than its greatest width; segment 1 very short and transverse, 2 short, 3 longer than 1 and 2 or 4-6 united; 1 and most of 2 striate, 3 smooth and polished, 4-6 with

a few fine setae. Legs slender; posterior tarsi no longer than their tibiae, their basal joint equal to 2-4 united. Length, 1·1 mm.

Described from one female, labelled "Norfolk Island, A. M. Lea." Type, I. 14571, South Australian Museum.

Of the Australian species, closest to *T. nigripes*, Dodd, but that species has the antennae wholly concolorous, the legs darker, the scutum closely punctured.

HOPLOGRYON, Ashmead.

A well-represented genus in the Australian fauna. The species described herewith has the abdomen much broader at its base than usual; moreover, no mainland species with aborted wings has yet been discovered.

Hoplogryon howensis, n. sp.

♀. Dark brown or fuscous, the first abdominal segment reddish, the scutum dull red; legs fuscous, suffused somewhat with yellow, the tarsi pallid; antennae fuscous, the scape yellowish, the pedicel less so.

Head normal, slightly wider than the thorax, the vertex thin, the frons broad; viewed from in front, rather wider than deep; with dense, polygonal, surface sculpture, and a few, short, fine setae; around mouth with converging striae; eyes moderately large, bare; ocelli very small, the lateral pair somewhat nearer to the median ocellus than to the eyes. Antennae 12-jointed; scape moderately slender, as long as next four joints combined; pedicel short, a little longer than its greatest width; funicle 1 as wide and almost as long as the pedicel, 2 a little shorter than 1, 3 a little shorter than 2, 4 a little shorter than 3 and somewhat longer than wide; club rather slender, 6-jointed; joint 1 quadrate, 2-5 wider than long. Thorax stout, hardly longer than its greatest width; scutum and scutellum with dense, polygonal, surface sculpture, and very fine pubescence; parapsidal furrows absent; scutellum semicircular; post-scutellum at meson with a very small tooth; median segment very short, its caudo-lateral angles toothed. Forewings represented by mere flaps that hardly reach to base of abdomen. Abdomen broadly oval, not much narrowed at base, broadly rounded posteriorly, somewhat wider than the thorax, rather less than twice as long as its greatest width; segment 1 very short, transverse; 2 much longer than 1; 3 as long as wide, more than twice as long as 2; 4-6 short; 1 and extreme base of 2 striate, the rest with dense, polygonal, surface sculpture and very fine scattered pubescence. Legs slender; posterior tarsi no longer than their tibiae, their basal joint as long as 2-5 united. Length, 1·3 mm.

Described from one female, labelled "Lord Howe Island, A. M. Lea." Type, I. 14572, South Australian Museum.

BARYCONUS, Foerster.

Three species are included in this genus, in its present Australian sense; two are closely related to each other, but differ widely from any of the mainland forms; the third is apparently a modified member of one of the Australian groups.

Baryconus discolor, n. sp.

♀. Head pallid yellow, the frontal depression fuscous, the eyes and ocelli black; scutum pale yellow, dusky around the tegulae, and with an oblong brown patch at meson of anterior half; pronotum and scutellum deeper yellow; tegulae pale; sides and venter of thorax (except the pale mesosternum) dusky black; first abdominal segment yellow, 2 and 3 blackish, the former yellowish at base, the latter with an irregular yellow band across base, 4 and 5 brown, each with

a yellow band across base, 6 yellow; venter of abdomen pallid; legs, including the coxae, pale yellow, the tarsi brownish; antennae yellow-brown, the scape paler; mandibles pale yellow, the teeth black.

Head normal; vertex broad, not twice as wide as long, the occiput concave; from frontal aspect the head is subcircular, as wide as deep; lower half of frons at meson depressed, and with a median carina running from antennal insertion for some distance; surface densely punctured, the punctures of moderate size, and with short fine pubescence; frontal depression smooth; mouth with converging striae; mandibles tridentate, the teeth acute; eyes not large, scarcely longer than their distance from the occiput; ocelli small, wide apart, the lateral pair separated from the eyes by their own diameter. Antennae 12-jointed; scape normal, no longer than next two joints combined; pedicel more than twice as long as its greatest width; funicle 1 a little longer than pedicel, three times as long as its greatest width; 2 three-fifths as long as 1; 3 quadrate; 4 wider than long; club compact, 6-jointed, joints 1-5 much wider than long. Thorax scarcely as wide as the head, about twice as long as its greatest width; pronotum visible from its neck to the tegulae; scutum a little wider than long, narrowed anteriorly where it is sharply rounded; parapsidal furrows wanting; scutum and scutellum densely punctate and with fine pubescence like the head; scutellum short, its posterior margin straight; postscutellum and median segment excavated and hidden by the abdominal projection; propleurae depressed; mesopleurae punctate, with an elongate smooth meso-posterior path; metapleurae rugo-punctate. Wings vestigial, very narrow; forewings reaching nearly to apex of second abdominal segment, the discal cilia dense and somewhat coarse, the marginal cilia short; a little tinted; venation fuscous; submarginal vein attaining the costa somewhat beyond half-wing length, the marginal as long as the short, very oblique, stigmal vein, the postmarginal not developed. Abdomen almost twice as long as head and thorax united, spatulate, pointed at apex; segment 1 petioliform, twice as long as wide, 2 and 3 each as long as their greatest width and a little longer than 1, 4 and 5 wider than long and plainly shorter than 2 or 3, 6 somewhat longer than 5 and longer than its basal width; segment 1 with a blunt basal horn that projects into the thorax as far as the scutellum, strongly longitudinally rugo-striate, the apex of the horn smooth; 2 longitudinally striate; 3-6 with dense punctures and fine silvery pubescence, 3 with a smooth mesal path. Legs slender; posterior coxae long, not much shorter than their femora; posterior tibiae slender; basal joint of posterior tarsi very long, a little longer than 2-5 united and three-fifths as long as their tibiae. Length, 4 mm.

♂. Colorationally like the female; differs only in sexual characters, no basal horn of abdomen, the apical abdominal segment short. Antennae yellow-brown, paler at base than toward apex; scape moderately short and stout; pedicel twice as long as its greatest width; flagellar joints cylindrical, 1 longest, two-thirds longer than the pedicel, 9 one-half as long as 1. Forewings perfect, attaining apex of abdomen; broad; stained brownish; venation fuscous; submarginal vein attaining the costa at about half-wing length; marginal vein nearly one-half as long as the stigmal, which is long, oblique, a little convexly curved; postmarginal a little longer than the stigmal; basal vein distinct, somewhat oblique; median vein as an ill-defined thick line beyond the basal vein. Length, 3·5 mm.

Three females, one male, labelled "Lord Howe Island, A. M. Lea." Type, I. 14573, South Australian Museum.

Colorationally and structurally this species differs markedly from any of the known Australian forms.

Baryconus vestigialis, n. sp.

♀. Extremely like *B. discolor,* but differs in colour as follows: Head uniformly yellow-brown (not pale yellow), the frontal depression not black, the mandibles concolorous; thorax of a darker tint; abdomen dark brown or fuscous, the first segment concolorous, the yellow bands of *B. discolor* almost obliterated here. Structurally differs from *B. discolor* as follows: The median segment is not hidden by the abdominal projection and is moderately long, covered with very fine pubescence; the horn on the basal abdominal segment does not project forward into the thorax; the abdomen is shorter, one-half longer than the head and thorax united, segment 1 less than twice as long as wide, 6 no longer than its width at base; pubescence denser on segments 3-6, 2 also with some pubescence; wings still narrower and shorter, scarcely reaching beyond base of second abdominal segment, the venation obscure, the stigmal vein seemingly not developed. Length, 3 mm.

Four females, labelled "Mt. Gower and Lord Howe Island, A. M. Lea." Type, I. 14574, South Australian Museum.

The colour varies slightly; in three specimens the posterior coxae and femora are somewhat dusky. A smaller, duller species than *B. discolor;* the strikingly similar colour pattern led me at first to regard it as a variety of that species, but the several slight structural differences would seem to denote specific rank; the distinctions are negative rather than positive.

Baryconus vestitus, n. sp.

♀. Head black; thorax bright orange or yellow-brown; abdomen fuscous, the third segment yellow for its basal half; legs, including the coxae, bright yellow; antennae fuscous, the scape yellow.

Head normal; vertex rather long, twice as wide as long; from frontal aspect, the head is somewhat wider than deep; vertex and upper frons densely finely punctate and coriaceous, and with scattered short pubescence; lower half, or less, of face, feebly depressed, with a median carina running from antennal insertion, the depression finely transversely alutaceous; cheeks narrow, finely longitudinally alutaceous; mouth with very fine converging striae; eyes large, extending to the occiput, and as far as a line drawn across antennal insertion, bare; ocelli very small, wide apart, the lateral pair against the eyes. Antennae 12-jointed; scape normal, as long as the next four joints combined; pedicel one-third longer than its greatest width; funicle 1 plainly longer than pedicel, fully twice as long as its greatest width, 2 shorter than 1, 3 quadrate, 4 wider than long; club compact, 6-jointed, joints 1-5 transverse, 1 smaller than the others. Thorax not much longer than its greatest width; pronotum hardly visible from above; scutum large, broadly rounded anteriorly, the parapsidal furrows absent; scutellum semicircular; scutum and scutellum finely, very densely coriaceous and punctate, and with rather dense, short, black pubescence; postscutellum hidden; median segment concave, not visible medially, its latero-posterior angles acute; propleurae with fine surface sculpture; meso- and metapleurae punctate, the former with a smooth, elongate, meso-posterior depression. Wings vestigial; short, narrow flaps. Abdomen fusiform; narrowed at base, pointed at apex; one-half longer than the head and thorax united; segment 1 short, fully twice as wide as long, with a rounded prominence or bosse at base; 2 more than twice as long as 1, somewhat shorter than its width at posterior margin; 3 a little longer than 2, scarcely as long as wide; 4 one-half as long as 3, as long as 5 and 6 combined; 1 striate, its prominence reticulate; base of 2 striate; the rest with a very dense, fine, surface sculpture, and very dense clothing of short black setae. Legs normal; posterior tarsi

not as long as their slender tibiae, their basal joint as long as 2-5 united. Length, 2·3 mm.

Described from one female, labelled "Lord Howe Island, A. M. Lea." Type, I. 14575, South Australian Museum.

Although the basal abdominal segment is shorter, its prominence not conspicuous, and the abdomen more fusiform, the affinities of this species are probably with the group of Australian species that contains *B. splendidus*, Dodd, *B. magnificus*, Dodd, *B. superbus*, Dodd, and others.

Hadronotus, Foerster.

There is a single male belonging to this genus, and closely related to *H. parvipennis*, Dodd, labelled "Rotting leaves, Norfolk Island, A. M. Lea." The species described herewith is not a true member of the genus, and is placed there for lack of a suitable position.

Hadronotus terrestris, n. sp.

♀. Head black; thorax bright orange or yellow-brown, the meso- and metapleurae darker; abdomen fuscous, with two irregular yellow bands at bases of segments 2 and 3; legs wholly yellow; antennae fuscous, the scape yellow.

Head slightly wider than the thorax, the vertex of normal length; from lateral aspect, vertex and frons gently, regularly convex; occiput not margined; viewed from in front, the head is plainly wider than deep; lower half, or less, of face a little depressed, with a blunt median carina, very finely, circularly striate; mouth with fine converging striae; vertex and upper frons finely, very densely coriaceous; eyes moderately large, extending almost to occipital margin; ocelli minute, very wide apart, the lateral pair against the eyes. Antennae normal, 12-jointed; scape moderately long and slender; pedicel scarcely longer than its greatest width; funicle 1 a little longer than pedicel, 2 quadrate, 3 wider than long, 4 very small, transverse; club compact, 6-jointed, joints 1-5 transverse. Thorax stout, no longer than its greatest width; pronotum not visible from above; scutum large, very broadly rounded anteriorly, the parapsidal furrows absent; scutellum semicircular; scutum and scutellum with fine surface sculpture and fine, dense, black pubescence; postscutellum and median segment not visible, except the latero-posterior angles of the latter, the thorax at meson abruptly terminating at apex of scutellum. Wings vestigial; very short and narrow flaps. Abdomen a little longer than the thorax, and more than twice as long as its greatest width; hardly narrowed at base, pointed at apex; segment 1 broadly sessile, very short and transverse; 2 large; 3 slightly longer than 2, somewhat wider than long, as long as 4-6 united; abdomen wholly clothed with a very dense, fine pubescence, and with microscopic sculpture. Legs slender; posterior tarsi hardly as long as their slender tibiae, their basal joint about as long as 2-5 united. Length, 1·6 mm.

♂. Agreeing in all particulars with the female. Antennae 12-jointed; pedicel small, no longer than wide; funicle 1 twice as long as wide, 2-9 gradually shortening, 9 slightly longer than wide, 10 as long as 1.

Described from nine females, three males, labelled "Fallen leaves, Lord Howe Island, A. M. Lea." Type, I. 14577, South Australian Museum.

The yellow bands on the abdomen vary somewhat in length. One male has the thorax deep chestnut, the abdomen wholly fuscous. This species may well be a wingless form of *Hadronotus*, but the abdomen is longer than is usual in that genus.

TELENOMUS, Haliday.

One male, labelled "Lord Howe Island, A. M. Lea."

Family DIAPRIIDAE.

TETRAMOPRIA, Wasmann. Dodd, Trans. Roy. Soc. S. Austr., 1916.

The species described below agrees with the characters of the two Australian species; the three ought possibly to form a new genus. In Kieffer's table of genera (1911), they run to *Tetramopria*, Wasmann, and *Geodiapria*, Kieffer, but differ from both in lacking a basal fovea to the scutellum.

Tetramopria plana, n. sp.

♀. Dull black; legs, including the coxae, bright yellow; petiole of abdomen reddish; tegulae yellowish; antennae yellow, the three apical joints fuscous.

Head depressed; from dorsal aspect somewhat longer than wide, truncate anteriorly, and irregularly pentagonal in outline, the antennae inserted against anterior margin; eyes small, situated rather far forward, distinctly shorter than their distance from the occiput; ocelli close together, plainly nearer the occiput than the anterior margin; surface smooth and shining. Antennae 12-jointed; scape moderately long and slender; pedicel narrowed at base, three times as long as its greatest width; funicle joints narrower than the pedicel and much shorter; funicle 1 narrowed at base, twice as long as its greatest width, 2-7 gradually shortening, 7 a little longer than wide; club abruptly 3-jointed, the joints longer than wide. Thorax depressed; pronotum very short; scutum and scutellum flat, smooth and shining; parapsidal furrows wanting; scutellum as long as wide, without a median carina or basal foveae; median segment long, as long as the scutellum, finely rugose, with a distinct median and lateral carinae. Forewings extending well beyond apex of abdomen; subhyaline; moderately narrow, the margins equally inclined; marginal cilia very long, the longest equal to more than one-half greatest wing width; discal cilia not very dense; venation yellowish, terminating in a short, thickened, marginal vein at basal third of wing; basal vein absent. Petiole of abdomen slender, more than twice as long as wide, densely pubescent; body of abdomen depressed, twice as long as its greatest width, its base distinctly separated from the petiole, its basal segment fully twice as long as the following united, smooth and shining. Length, 1·75 mm.

♂. Body less depressed than in the female, the head no longer than wide. Antennae 14-jointed; scape and pedicel yellow, the flagellar joints fuscous, their basal stalks yellowish; scape normal; pedicel short and stout; flagellar joints nodiform, long, about subequal, with a pubescence of scattered long hairs.

Described from one female, labelled "Lord Howe Island, A. M. Lea," and one male, labelled "Norfolk Island, A. M. Lea." Type, I. 14579, South Australian Museum.

Differs from the other Australian species in having the female antennal club 3-jointed.

Phaenopria norfolcensis, n. sp.

♀. Head and abdomen black; thorax chestnut-red; legs bright golden-yellow; antennae golden-yellow, the club fuscous.

Head normal, from dorsal aspect as wide as long, from lateral aspect not as long as its height; smooth and polished, with a very few scattered setae; ocelli absent; eyes small, situated anteriorly and somewhat laterally, not as long by much as their distance from the occipital margin. Antennae 12-jointed; scape long and slender; pedicel fully twice as long as its greatest width; funicle joints shorter and somewhat narrower than the pedicel, 1 one-half longer than

wide, 7 wider than long; club abrupt, 3-jointed, joints 1 and 2 somewhat wider than long, 2 wider than 1, 3 conical and one-half longer than wide. Thorax compressed, much narrower than the head or abdomen, over three times as long as its greatest width; scutum and scutellum smooth and shining; scutum longer than its greatest width, without furrows; scutellum somewhat longer than wide, without a trace of basal foveae, its rim pubescent; median segment long, rather longer than the scutellum, with a clothing of long silvery pubescence. Wings entirely wanting. Petiole of abdomen short, no longer than wide, densely pubescent; body of abdomen smooth and shining, two and a half times as long as its greatest width, the basal segment occupying almost all of surface. Length, 1·5-1·75 mm.

♂. Ocelli present, small; thorax rather less compressed; wings present as narrow flaps that reach the posterior margin of the petiole; basal abdominal segment occupying less than three-fourths of surface. Antennae 14-jointed; pedicel twice as long as its greatest width; funicle 1 a little longer than the pedicel; 2 one-half longer than 1, curved and dilated on one margin at apex; 3 as long as 1; 3-12 moniliform, each bearing a few, long, fine setae.

Described from three females, one male, labelled "Rotting leaves, Norfolk Island, A. M. Lea." Type, I. 14580, South Australian Museum, one female.

An allied wingless form, *Loxotropa grandiceps*, Dodd, has been described from New South Wales, which differs at once in having a basal fovea to the scutellum.

SPILOMICRUS, Westwood.

The collection contains one female, labelled "Rotting leaves, Norfolk Island, A. M. Lea"; this is very closely allied to *S. gracilis*, Dodd, and may not be distinct. A second species is represented, which belongs to the group of species described by me under the genus *Bothriopria*, and subsequently referred to *Spilomicrus*.

Spilomicrus howensis, n. sp.

♀. Black, the antennae wholly concolorous; legs dull yellow, the coxae and femora brown; tegulae reddish.

Head from dorsal aspect subquadrate, not much wider than long; viewed from the side, higher than long, the frons perpendicular to antennal insertion, which is not conspicuous; surface smooth and shining, with numerous, scattered, long, fine setae; eyes small, not as long as their distance from the occiput. Antennae 13-jointed; scape slender, terminating acutely on either side of base of pedicel; pedicel twice as long as its greatest width; funicle joints plainly narrower and shorter than pedicel, 1 twice as long as wide, 2 slightly longer than wide, 6 slightly widened and as wide as long; club 5-jointed, joint 1 not as wide as 2, 1-4 a little wider than long, the apical joint a little longer than the preceding. Thorax fully twice as long as its greatest width; pronotum with long dense pubescence; scutum rather flat, with a few scattered setae, the parapsidal furrows as distant grooves posteriorly and about one-half complete; scutellum at base with two circular foveae a little separated, the lateral foveae shallow and long, the posterior margin finely foveate; median segment fully as long as the scutellum, feebly pubescent and obscurely rugose, with distinct lateral carinae and an obscure raised tooth at base. Forewings reaching apex of abdomen; moderately broad, the apex sharply rounded; stained brownish; venation terminating at almost half-wing length in a short, thickened, marginal vein, the stigmal vein very short; basal vein well marked. Petiole of abdomen twice as long as wide, tricarinate, its basal half pubescent; body of abdomen well raised from petiole, oval, rounded posteriorly, rather more than twice as long

as its greatest width; smooth and shining; segment 2 occupying three-fourths of surface, the following segments with a few long setae. Length, 2 mm.

Described from two females, labelled respectively "Summit of Mt. Gower, Lord Howe Island, A. M. Lea," and "On *Kentia,* Lord Howe Island, A. M. Lea." Type, I. 14582, South. Australian Museum.

Of the Australian species, quite close to *S. aureipes,* Dodd, *S. ater,* Dodd, and *S. infuscipes,* Dodd, but the more quadrate head and small eyes will serve to distinguish it.

Family PLATYGASTERIDAE.

No systematic work has yet been done on this group in Australia; the species must be very numerous, and a few have been described. Ashmead's classification of 1893 has been used as a basis, when referring species to genera.

Trichacis howensis, n. sp.

♀. Black, shining; legs, including the coxae, bright golden-yellow; antennal scape yellow, also the first funicle joint, the pedicel fuscous, the antennae otherwise black; mandibles reddish-yellow.

Head normal; vertex thin, transverse, and showing very faint, fine, impressed sculpture; viewed from in front as wide as deep, the frons smooth and shining; antennae inserted just above the mouth, in a circular depression, and separated by a small tubercle; a few, fine, weak hairs are around antennal depression, and there is a scattered row of these same fine hairs against the eyes; mandibles long, slender, bidentate, the teeth acute; eyes moderately large, bare; ocelli wide apart, the lateral ones separated from the eyes by about their own diameter. Antennae 10-jointed; scape long and slender, as long as next five joints combined; pedicel small, hardly longer than its greatest width; funicle 1 minute, cupuliform, no longer than its greatest width, 2 twice as long as wide, and almost twice as long as pedicel, 3 plainly shorter than 2, 4 very small and no longer than wide; club 4-jointed, no wider than the funicle, loosely jointed, the joints much longer than wide, 1 subequal to 4 and slightly longer than 2 or 3, as long as funicle 2. Thorax normal, not twice as long as its greatest width; pronotum smooth and shining, with a very few, fine, weak hairs, the sclerite distinct laterally and dorsally; scutum somewhat narrowed anteriorly, one-half longer than its greatest width, its meson at posterior margin produced into the scutellum for some distance, smooth and shining, a scattered line of white, fine hairs follows the anterior and lateral margins; parapsidal furrows not evident, but a line of fine white hairs marks their course; scutellum small, not distinctly separated from the scutum, raised medially, rather abruptly declivous laterally and posteriorly, covered with a dense, fine, whitish pubescence except at extreme meson; median segment very short; pleurae smooth and shining, the metapleurae with rather dense pubescence. Forewings extending somewhat beyond apex of abdomen; broad, hardly more than twice as long as the greatest width; faintly tinted, except at base; marginal cilia fine, short, and dense; discal cilia almost absent on basal two-thirds of wing, the apical third with about 24 rows of cilia, which are much more dense toward anterior than toward posterior margin; a short submarginal vein is indicated. Petiole of abdomen very short, transverse; body of abdomen no longer than head and thorax combined, two and a half times as long as its greatest width; composed of four segments; segment 2 (first body segment) as long as 3-5 combined, at base with a pubescent fovea on either side of meson, and posterior of each fovea finely striate for some distance, the rest smooth and shining; 3 and 4 subequal, 3 at base with a transverse row of close punctures, 4 with its basal

half punctate; 5 as a conical projection, hardly longer than 4, and almost twice as long as its greatest width. Legs slender, the tarsi 5-jointed. Length, 1 mm.

Described from ten females, labelled "Lord Howe Island, A. M. Lea." Type, I. 14583, South Australian Museum.

Amblyaspis flavibrunneus, n. sp.

♀. Bright brownish-yellow or castaneous, the head, prothorax, and metathorax yellow; eyes and ocelli black; legs golden-yellow, the femora and clavate portion of tibiae suffused with brown; antennae brownish-yellow, the club fuscous.

Head normal; vertex transverse, with very fine impressed reticulation; viewed from in front the head is slightly wider than deep, the frons smooth and not depressed; eyes rather long, extending for almost the length of the frons; ocelli wide apart, the lateral pair a little separated from the eyes. Antennae separated by a small tubercle; 10-jointed; scape almost as long as next five joints combined, very slender, swollen at half its length; pedicel slender, three times as long as its greatest width; funicle joints very slender, narrower than pedicel, 1 two-thirds as long as pedicel; 2 slightly longer than 1, 3 one-half as long as 2, 4 a little shorter than 3; club slender, 4-jointed, joint 1 cupuliform and twice as long as its greatest width, as long as funicle 2, 2 and 3 subequal, barely as long as 1 and not much longer than wide, 4 one-half longer than 3. Thorax normal, twice as long as its greatest width; pronotum prominent anteriorly and laterally, opaque; scutum narrowed anteriorly, somewhat longer than its greatest width, with very fine, dense, impressed reticulation or scaly sculpture, the parapsidal furrows replaced by a complete line (composed of several rows) of fine, dense, pallid pubescence; scutellum raised, covered with fine, dense, pale pubescence, produced posteriorly in a long slender spine high above the median segment for almost its entire length; median segment long, with rather long fine pubescence, rimmed laterally, and with a thick, high, median carina. Forewings very long, extending far beyond apex of abdomen; moderately broad, about four times as long as their greatest width; hyaline for less than basal third, the rest somewhat tinted; longest marginal cilia equal to one-fourth wing width; discal cilia excessively dense right up to base of wing; submarginal vein faintly indicated; hindwings very narrow and pointed, hyaline for basal third, their longest marginal cilia equal to the greatest width, the discal cilia exceedingly dense. Petiole of abdomen no longer than wide, pubescent; body of abdomen ovoid, hardly twice as long as its greatest width, broadly rounded posteriorly; smooth; basal segment occupying three-fourths of surface, the others very short. Legs slender; all trochanters very long, as long or longer than their coxae, and half as long as their femora; femora a little swollen in centre; tibiae with a long basal stalk, which in the long posterior pair is almost twice as long as the apical swollen portion; tarsi slender, 5-jointed; posterior tarsi somewhat longer than their tibiae, their basal joint as long as 2-5 combined. Length, 1·3 mm.

Described from two females, labelled "On *Kentia canterburyana*, Mt. Ledgbird, Lord Howe Island, A. M. Lea." Type, I. 14584, South Australian Museum.

Family BETHYLIDAE.

Sclerodermus norfolcensis, n. sp.

♀. Dull black, the abdomen piceous; legs piceous, the tibiae and tarsi testaceous; antennal scape brownish-yellow, also the next two or three joints, the rest of the antennae piceous.

Body completely flattened, from lateral aspect appearing strongly compressed. Head, viewed from above, plainly longer than wide, with dense, polygonal, scaly sculpture; hind margins rounded, the lateral margins parallel, the clypeus truncate; eyes normal, situated far forward, not as long as their distance from the posterior margin of the head; ocelli close together near the posterior margin, the lateral parts separated from each other by less than their own diameter, separated from the frontal ocellus by their own diameter; a fine groove runs from just inside of each antennal insertion, joining medially and continued as an obscure groove for half the length of the head; mandibles dusky, long, straight, tridentate, the teeth acute, the outer longest, the inner one small; maxillary palpi at least 3-jointed. Antennae short, 13-jointed; scape stout, somewhat clavate, as long as the next four joints combined; pedicel one-third longer than its greatest width; funicle 1 plainly shorter than the pedicel, no longer than its greatest width, 3 longest (not including the apical joint), but hardly as long as the pedicel, 4-10 gradually shortening, 10 a little longer than wide, the last joint twice as long as the penultimate. Thorax a little narrower than the head or abdomen, three times as long as its greatest width; with similar polygonal sculpture to that of the head, but on the median segment this is coarser and inclines towards reticulation; pronotum as long as its greatest width, as long as the scutum and scutellum combined, rounded anteriorly; scutum without a trace of furrows, more than twice as wide as long; scutellum without a transverse groove at base, its posterior margin gently convex; median segment distinctly longer than its greatest width, without grooves or carinae, not retracted at base, its posterior angles rounded; tegulae present in both winged and apterous forms. Wings wanting, or fully developed; in the winged form, forewings long, faintly tinted, with no venation except a short submarginal vein that thickens at the apex and touches the costa, forming a closed costal cell. Abdomen not twice as long as its greatest width; pointed ovate; with fine, scaly, surface sculpture. Legs short; all femora very much swollen; tibiae not spined; posterior tibiae with two apical spurs, one short, the other long and slightly curved; tarsal claws simple. Length, 3 mm.

Described from four females, labelled "Rotting leaves, Norfolk Island, A. M. Lea." Type, 14585, South Australian Museum.

Of the four specimens, three are apterous; there appear to be no structural differences between the two forms. The species does not agree with the characters of *Sclerodermus* as given by Kieffer (1908); the wing venation resembles *Cephalanomia*, but that genus has 12-jointed antennae.

Arysepyris citripes, n. sp.

♀. Dull black, the abdomen somewhat piceous; legs, including the coxae, wholly intense lemon-yellow; antennae dull yellow, the basal three or four joints intense yellow.

Head shaped as in *Goniozus* and its allies, its greatest length rather more than its greatest width, narrowed and produced in front of the eyes, the mandibles thus not prominent; surface with fine, impressed, scaly reticulation and a few, scattered, fine setae; eyes about as long as their distance from the occipital margin; ocelli almost equidistant from one another, the lateral (and posterior) pair much closer to the occipital margin than to the median ocellus. Antennae 13-jointed; scape stout, rather less than twice as long as its greatest width; pedicel longer than any of the funicle joints, about twice as long as its greatest width; funicle 1 narrowed at base, one-third longer than its greatest width, slightly the longest joint of the funicle, 2 the shortest and quadrate, 3-10 subequal, moniliform, slightly longer than wide, the apical joint a little longer than

the preceding. Thorax long, rather more than twice as long as its greatest width; pronotum as long as the scutum and scutellum combined, somewhat wider than long; scutum transverse, without furrows; scutellum without a groove or fovea at base; median segment as long as the pronotum, without grooves or carinae, immargined laterally, abruptly declivious posteriorly; thorax with similar sculpture to the head. Wings represented by flaps which attain the base of the median segment. Abdomen pointed conic-ovate. Legs normal; anterior femora much swollen, more so than the posterior pair; all tarsi simple. Length, 1·5 mm.

Described from seven females, labelled "Lord Howe Island, A. M. Lea." Type, I. 14586, South Australian Museum.

Sierola, Cameron.

Although very few species have been described, this genus would appear to be particularly well represented in the Australian region. This collection contains a series of specimens, probably representing more than one species, from both Lord Howe and Norfolk Islands.

Family DRYINIDAE.

Gonatopus, Ljungh.

One female, labelled "Lord Howe Island, A. M. Lea," is referable to this genus, in its wider sense. No attempt was made to dissect out the mouth parts.

ON THE SPECIALISED INCISOR TEETH OF SOME OF THE DIDACTYLOUS MARSUPIALS.

By Frederic Wood Jones, D.Sc., F.Z.S.,

Professor of Anatomy in the University of Adelaide.

[Read August 14, 1924.]

I have suggested elsewhere (Mammals of South Australia, part ii., p. 135) that the reason for the development of the syndactylous toilet digits in the diprotodont marsupials is a direct outcome of the dental condition of this section of the didelphia. The marsupials have need of a hair comb, the need probably being the necessity of ridding the fur of the presence of *Mallophaga,* or biting lice, which so commonly infest them. This need is met in the typical polyprotodonts by nibbling the fur with the numerous little sharp front teeth, aided by scratching with the pes. When, in response to an altered diet, the nature of

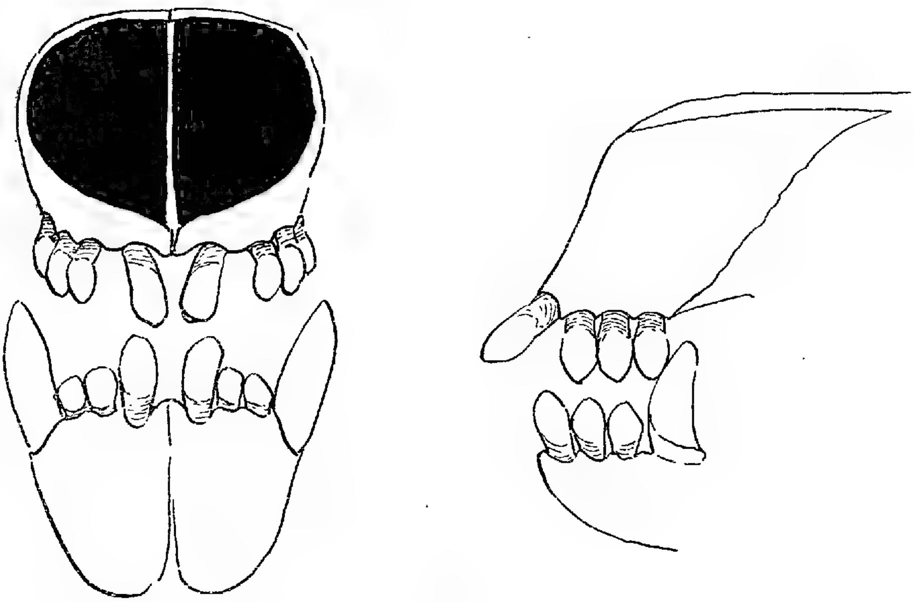

Fig. 1.
The anterior teeth of *Dasycercus cristicauda.* Front and side views.

the dentition is changed and the numerous little pointed front teeth are replaced by the few chisel-shaped incisors, the pedal hair comb becomes more specialised and the syndactylous second and third pedal digits are developed.

Even before the front teeth have become few in number, and at the stage when they have only lost their pointed character, the pedal hair comb is developed. The members of the Peramelidae possess the syndactylous pedal hair comb, despite the fact that their front teeth are numerous. A bandicoot is a polyprotodont, and has five upper and three lower incisors upon each side of its jaws; but the incisors are no longer of the same type as those seen in the rest

of the polyprotodonts, for they have lost their prong-like character and have become chisel-shaped.

That teeth should be used in the toilet of the hair is no surprising thing; everyone must have seen a dog nibble its coat in the effort to dislodge or to capture a flea. I have frequently watched the little carnivorous Pouched Mice *(Dasycercus cristicauda)* engaged upon the toilet of the coat. These attractive little animals scratch themselves vigorously with the digits of the pes; but if any part of their body demands especial attention, they turn their heads and nibble and comb their hair in a very characteristic fashion. From these observations I have been for some time convinced that the front teeth and the syndactylous digits were complementary structures, vicariously discharging the same functions; and have already suggested that the little sharp front teeth of certain animals are probably of more importance as toilet implements than as organs connected with alimentation. It is only of late, however, that, in watching *Dasycercus* at its toilet, I have come to realize that there is a remarkable specialisation of its front teeth which is, as far as I can determine, related solely to the function of hair combing. Of the eight incisors carried in the upper jaw, two, the central members, are in every way abnormal (see fig. 1). These two teeth are remarkable, not only in their form, but in the axis in which they are carried in the jaw, for they rake forward at an angle which carries them out of

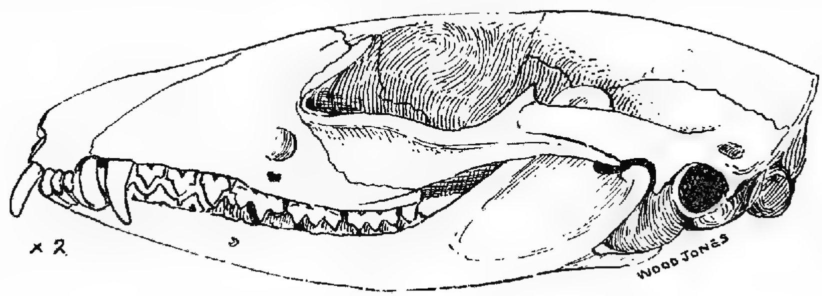

Fig. 2.
Left lateral view of the skull of *Phascogale penicillata.*

alignment with all the rest of the teeth. So marked is this projection of the upper central incisors that, in the normal position of the jaws, they do not articulate with the corresponding members of the mandibular series. The upper central incisors are large teeth, larger and longer than their fellows, from which they are separated by an interval which exceeds their own diameter. They are also separated from each other by a slightly smaller interval in the mid line, and at their tips they somewhat tend to approach each other. The corresponding lower central incisors are also specialised, being considerably longer and larger than their fellows, and separated from each other in the mid line by an interval similar to that which separates the incisors of the upper jaw. When the jaws are opened and shut it will be seen that these specialised front teeth do not bite together as the other incisors do, but the lower centrals close behind the upper centrals, their "occlusal" surfaces failing to articulate. It is impossible, after having watched the animal at its toilet, to avoid the conclusion that these specialised, projecting incisors, separated by a median gap, are the functional counterpart of the little parallel claws of the syndactylous pedal digits. Indeed, it is difficult to postulate any other function from them.

Dasycercus is not the only didactylous didelphian exhibiting this specialisation of the anterior teeth, for, with the exception of *Sarcophilus,* all the species which I have been able to examine show the peculiarity in some degree. The

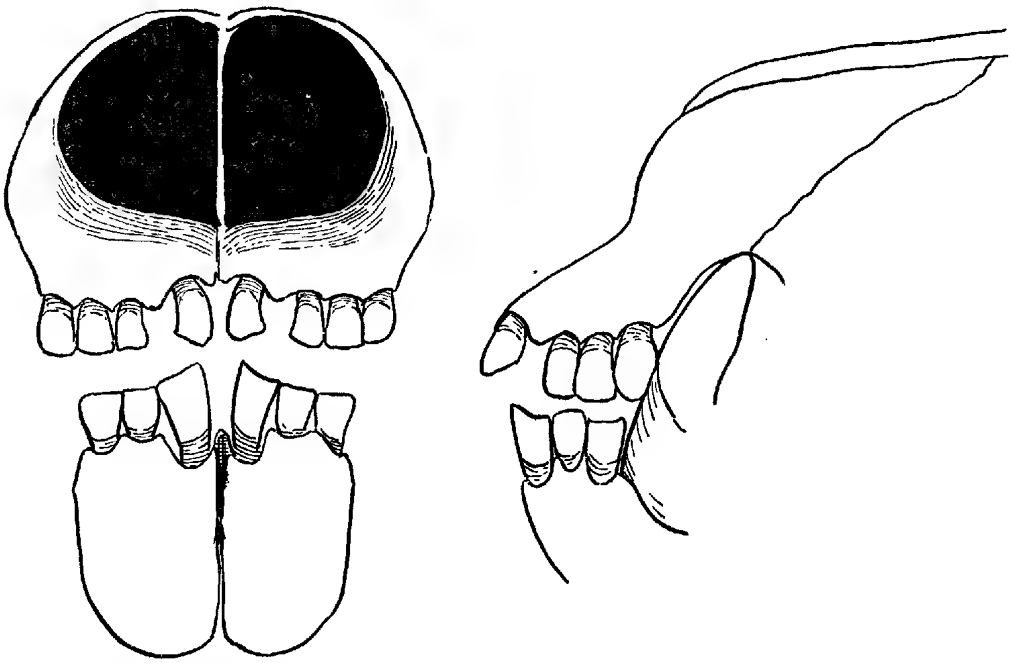

Fig. 3.
The anterior teeth of *Dasyurus geoffroyi*. Front and side views.

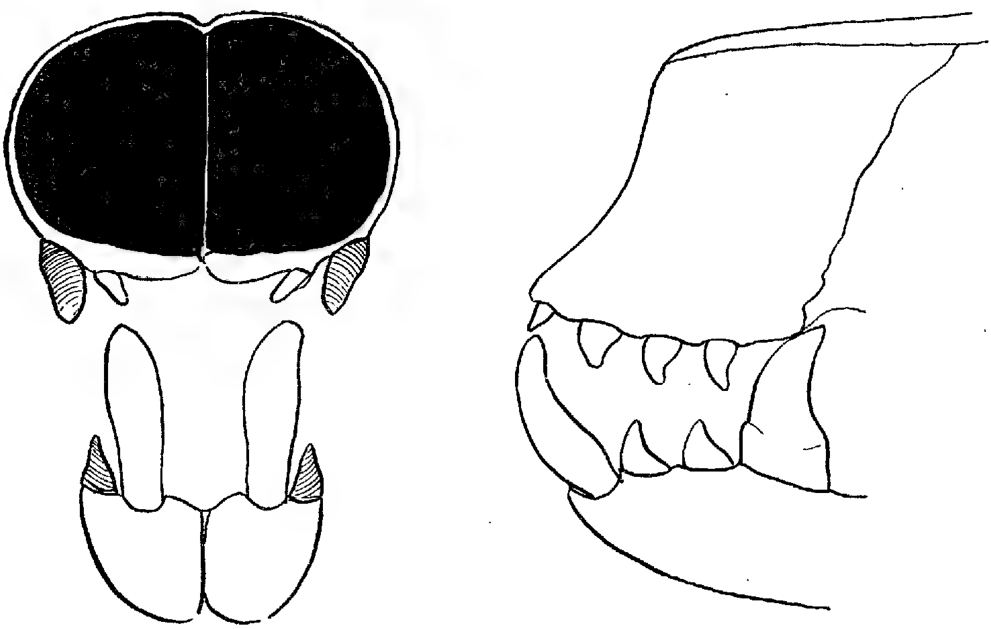

Fig. 4.
The anterior teeth of *Myrmecobius fascialus*. Front and side views.

various members of the genus *Phascogale* display the long, projecting, upper central incisors in a still higher degree of specialisation, and the condition is illustrated in *Phascogale penicillata* at fig. 2.

In the Native Cats the differentiation of the front teeth is not so pronounced; but, nevertheless, the peculiarity is quite obvious, for the upper central incisors cant forwards and are separated from each other and from their fellows. The lower central incisors are also large, distinct in form, and separated in the mid line. The condition in *Dasyurus geoffroyi* is shown at fig. 3.

Perhaps the most interesting modification of the anterior teeth is that seen in *Myrmecobius*, for here it is the lower incisors which are the most highly

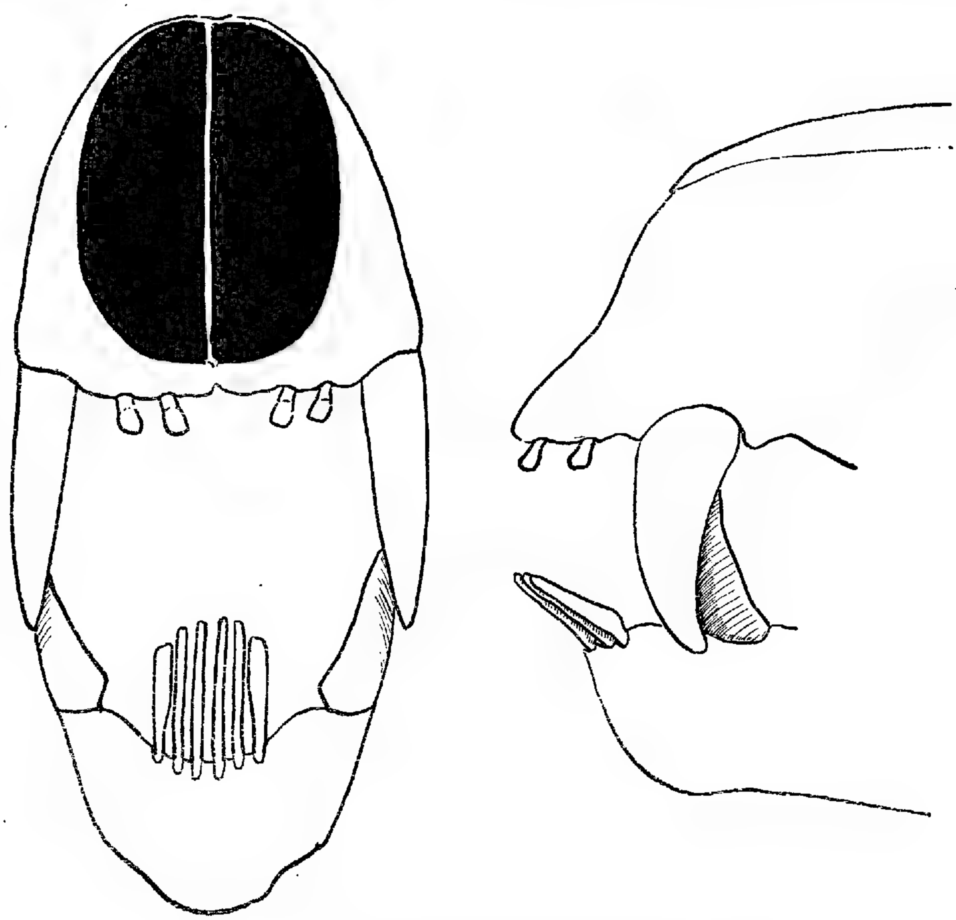

Fig. 5.
The anterior teeth of *Lemur catta*. Front and side views.

specialised, the upper central incisors being very small but sharply pointed. In *Myrmecobius* the teeth are more widely separated in the mid line than they are in the Pouched Mice, and it is to be hazarded if this modification is associated with the coarse, hispid hairs which constitute the animal's coat. The lower central incisors of *Myrmecobius* are relatively very large teeth and are peculiar in their form (see fig. 4). The special interest attached to these teeth of the Numbat lies in the fact that the dentition of the creature is obviously in a state of degeneration. In the midst of this degeneration the two lower central incisors

stand out in marked contrast, and it might almost be said that they are practically the only undegenerate teeth that the animal possesses.

That mammalian teeth should be specialised as toilet implements is no novelty in the marsupials, for parallels are to be found in the monodelphians. Although Frédéric Cuvier, as long ago as 1829 (Hist. Nat. Mammif., p. 218) described the curious lower front teeth of the *Lemur* (see fig. 5) as "veritables peignes," the fact is still not appreciated by some authors. W. K. Gregory in his monograph on the Structure and Relations of *Notharctus* (Mem. Amer. Mus. Nat. Hist., N.S., vol. iii., part ii., 1920, p. 203) has altogether overlooked this functional modification of the Lemur's lower front teeth and has ascribed their peculiarity to their being "pressed outward and forward by the greatly enlarged tongue."

In 1918 (Jour. Anat., vol. lii., p. 346) the present writer drew attention to the functional correlation between the lemurine sublingua and the peculiar procumbent front teeth, and noted the curious toilet specialisation of the front teeth of *Galeopithecus*. It is probable that patient observation of living animals will disclose many more instances of toilet modifications in the front teeth of the mammals. Meanwhile, this little contribution to the great study of structure and function demonstrates once again the vast plasticity of parts and organs, and especially of those, apparently, most rigid and stereotyped structures—the teeth. It demonstrates also how functions, which we might be apt to consider as trivial, demand their share of structural adaptations, and how, in the absence of a knowledge of function, however apparently humble it may be, deductions concerning structure are prone to be fallacious.

NEW GENERA AND SPECIES OF AUSTRALIAN STONE-FLIES (Order PERLARIA).

By R. J. Tillyard, M.A., Sc.D. (Cantab.), D.Sc. (Sydney), F.N.Z.Inst., F.L.S., F.E.S., C.M.Z.S., Entomologist and Chief of the Biological Department, Cawthron Institute, Nelson, N.Z.
(Communicated by Edgar R. Waite.)

[Read September 11, 1924.]

Family EUSTHENIIDAE.

Genus Eustheniopsis, Till.

Proc. Linn. Soc. N.S. Wales, 1921, xlvi., p. 232.

Eustheniopsis venosa, Till.

Subspecies *brachyptera*, n. subsp. A very distinct race or subspecies of this handsome Victorian species was discovered by me on Mount Kosciusko, N.S. Wales, in November, 1921. It differs from the type form in its small size and shortened wings, and in the lunule of the forewing being very narrow, less than 1 mm. wide. Length of forewing 12 mm., of hindwing 10 mm., of body 20 mm.; antennae 12 mm., cerci 11 mm. Purplish-blue colouring of hindwings not quite so rich as in type form. Both the specimens taken were males.

Types: Holotype male and paratype male (Mount Kosciusko, N.S. Wales, 5,500 feet, November 24, 1921, R. J. T.), in Cawthron Institute collection.

Genus Thaumatoperla, Till.

Proc. Linn. Soc. N.S. Wales, 1921, xlvi., p. 224.

Thaumatoperla robusta, Till.

A half-grown larva of this fine species has recently been taken by Mr. Erasmus Wilson in a mountain stream near Mount Bencairn, Millgrove, Victoria, where both male and female specimens of this rare insect have also been found by Mr. Wilson and Mr. C. G. Barrett. The larva is black, with the thoracic sterna, sutures, and coxae yellow, the femora tinged with olive-green beneath. A similar larva, full-fed and of great size (about 45 mm. long), was taken by me on Mount Kosciusko, N.S. Wales, in Nov., 1921; the underside had the yellow colouration replaced by brick-red. Thus we may conclude that either *T. robusta* itself, or a related, undescribed species, is to be found on Mount Kosciusko.

♂. Hitherto undescribed, differs from female as follows:—Total length of body 19 mm., forewing 18 mm., cerci 18 mm. The parts of the meso- and metathorax, coxae, and femora, which were described as either brown or greyish-yellow in the female, are bright yellow in the male. Seg. 9 hollowed out posteriorly above, broadly yellow on either side; tenth tergite narrowly yellow. Supra-anal plate with a forwardly curved copulatory hook, rather short; paraprocts short, blunt.

Types: Holotype female in National Museum, Melbourne; allotype male in Cawthron Institute collection, Nelson, N.Z.; both from Warburton, Vict.; male dated 4, 1915.

Family AUSTROPERLIDAE.

Genus Tasmanoperla, Till.

Canadian Entomologist, 1921, p. 40.

The following new species, from Mount Kosciusko, N.S. Wales, has the characters of the genus clearly marked, but superficially resembles the New

Zealand *Austroperla cyrene* (Newm.) in the lack of any mottling of the wings and in the weakness of the cross-veins in part of the distal area of the forewings.

Tasmanoperla ruficosta, n. sp.

♀. Length of body 12 mm., of forewing 13 mm., antennae 9 mm., cerci 0·7 mm., with very few segments. Body, legs, and antennae black. Wings fuscous with black veins, except the whole of the costal space to end of R_1 in both wings, which is brick-red (fading to yellow-ochreous in dead specimens) with darker reddish-brown venation. Distal cross-veins between branches of Rs, M, and Cu_1 very weak, colourless, rest very strong and black.

Types: Holotype female and series of five paratypes, all apparently females (Mount Kosciusko, N.S. Wales, 5,500 feet, Nov. 24, 1921, R. J. T.), in Cawthron Institute collection, Nelson, N.Z. Two of the paratypes have slightly shortened wings, length of forewing being 11 mm.

Family LEPTOPERLIDAE.

Genus Dinotoperla, Till.

Canadian Entomologist, 1921, p. 43.

Dinotoperla fasciata, n. sp.

♀. Length of body 6 mm., of forewing 10 mm., antenna 7 mm., cerci 1 mm. Head black, antennae dark brown; pronotum pale yellowish; rest of thorax black, abdomen dark brown. Forewings suffused with pale fuscous, venation darker fuscous; distal cross-veins surrounded by darker fuscous areas and so arranged that from three to four irregular transverse fasciae cross that part of the wing. Hindwings darker fuscous with a few darkened cross-veins placed distally between C, R_1, and Rs.

Types: Holotype female (National Park, Q'land, 1,500-2,000 feet., Dr. A. J. Turner), in Cawthron Institute collection, Nelson, N.Z.; paratype female, slightly smaller in size and with less distinct fasciae (same locality, Mar., 1921, G. H. Hardy), in Queensland Museum, Brisbane.

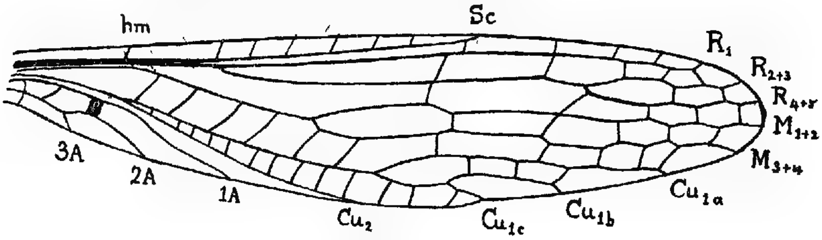

Fig. 1.

Forewing of *Trinotoperla irrorata*, n. g. et sp. Length, 25 mm. 1A, 2A, 3A, the three anal veins; Cu_{1a}, Cu_{1b}, Cu_{1c}, the three branches of first cubitus; Cu_2, second cubitus; *hm*, humeral veinlet; $M_{1\text{-}2}$ $M_{3\text{-}4}$, the two branches of media; R_1 main stem of radius; $R_{2\text{-}3}$ $R_{4\text{-}5}$, the two branches of radial sector (Rs); Sc, subcosta.

Genus Trinotoperla, n. g.

Forewings with Rs forked distally, M forked near middle of wing, Cu_1 three-branched (sometimes in males the lowest branch is very short and forms a closed cell with the one above it); cubito-anal space without cross-veins; a thickened cross-vein between 1A and 2A. Hindwing with Rs distally forked, M forked, Cu_1 simple, or, more rarely, forked; apex narrowly rounded; anal fan rather narrow, without any cross-veins. Cerci short. Size of species large, expanding from 40 mm. to over 50 mm.

Genotype: *T. irrorata*, n. sp., from Mount Kosciusko, N.S. Wales.

Trinotoperla irrorata, n. sp.

♀. Length of body 20 mm., of forewing 25 mm., antennae 17 mm., cerci bareiy 3 mm. Body dark fuscous, marked with dull brown; antennae dull brownish with slight fuscous annulations; legs dull brownish varied with dark fuscous. Wings pale greyish with dark-fuscous veins, those of basal half of hindwing inclining to brownish; the whole of forewing and distal part of hindwing irrorated with darker spots and patches, and most of the cross-veins enclosed in darker areas. Forewing with a complete series of costal veinlets; hindwings with *hm* and three to four distal costal veinlets only. Thickened cross-vein between 1A and 2A in forewing blackish, very prominent.

♂. Smaller and slightly paler and less strongly irrorated than female. Body 17 mm., forewing 21 mm.; supra-anal plate with slender copulatory process directed upwards and ending in a small hook directed posteriad; paraprocts upcurved, forming two flatly rounded lobes directed forward and upward. Tenth tergite with a raised flap distally.

Types: Holotype female, allotype male, and paratype female (Mount Kosciusko, N.S. Wales, 5,000-5,500 feet, Nov. 24, 1921, R. J. T.), in Cawthron Institute collection, Nelson, N.Z.

Trinotoperla australis, n. sp.

♀. Length of body 14 mm., of forewing 20 mm., antennae 15 mm., cerci 2 mm. Body, legs, and antennae fuscous; metathorax, abdomen, and femora touched with brown. Wings pale brownish-fuscous, with darker venation and cross-veins enclosed in narrow darkened areas; no irroration present. Both wings with costal veinlets very incomplete, only *hm* and one or two distal costal veinlets being present. Thickened cross vein between 1A and 2A of forewings inconspicuous, semi-transparent brownish.

Type: Holotype female (Towac, near Mount Canoblas, N.S. Wales, Oct. 7, 1916, R. J. T.), in Cawthron Institute collection, Nelson, N.Z.

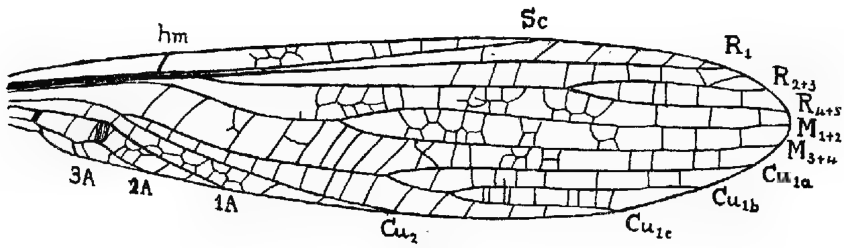

Fig. 2.
Forewing of *Eunotoperla kershawi*, n. g. et sp. Length, 25 mm. Lettering as in fig. 1.

Genus Eunotoperla, n. g.

Forewing with Rs distally forked or three-branched, M forked from near middle of wing, Cu_1 three-branched or, more rarely, simply forked; a thickened cross-vein between 1A and 2A; cells between M and Cu_1 partially double; cubito-anal space with cross-veins. Hindwing with Rs terminally forked or simple, M forked, Cu_1 forked or simple; apex well rounded; anal fan moderately wide, with a few weak cross-veins developed in region of 1A and 2A. Cerci short. Size of species large, expanding 50 mm. or more.

Genotype: *E. kershawi*, n. sp. (Vict.).

This genus shows an approach to the Eustheniidae in the beginning of the development of cross-veins on the anal fan, and is in other respects somewhat

similar in appearance to the genus *Stenoperla* of that family; it can be at once distinguished by the marked angle between the border of the anal fan and the rest of the hindwing, this angle being entirely absent in the Eustheniidae.

Eunotoperla kershawi, n. sp.

♂. Length of body (abdomen much shrunken) 11 mm., of forewing 25 mm., antennae 16 mm., cerci 4 mm. Body, legs, and antennae blackish, with front border of pronotum brownish. Wings dull brownish with dark-brown venation; cross-veins nearly all enclosed in pale transparent whitish areas; thickened cross-vein between 1A and 2A of forewing dark brown; supra-anal plate with a copulatory process in the form of a slender, downcurved spine; paraprocts with a pair of shorter, upcurved spines.

♀. Length of body (not shrunken) 25 mm., forewing 30 mm.; differs from male in having abdomen and pronotum brown, wings dark brown, the hindwings somewhat fuscous.

Types: Holotype male and allotype female (Warburton, Vict., 12, 94), in National Museum, Melbourne; paratype male, from same locality, in Cawthron Institute collection, Nelson, N.Z., also a male from Thorpdale, Gippsland.

Dedicated to Mr. J. A. Kershaw, F.L.S., Curator of the National Museum, Melbourne.

Family NEMOURIDAE.

Genus SPANIOCERCA, Till.

Trans. N.Z. Inst., vol. liv., 1923, p. 216.

The family has not previously been recorded from Australia, but is represented by species of this New Zealand genus in Tasmania and on the mountains of South-eastern Australia. Pending a more comprehensive study of the species, which are small and closely similar, the following species from Mount Wellington, near Hobart, is here described.

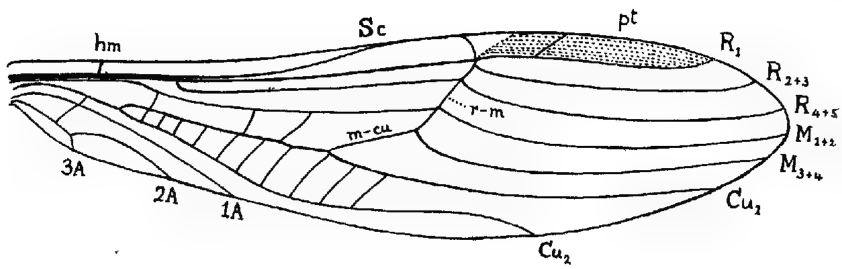

Fig. 3.

Forewing of *Spaniocerca tasmanica*, n. sp. Length, 10 mm. Lettering as in fig. 1, except Cu_1, first cubitus; *m-cu*, medio-cubital cross-vein, and *r-m*, radio-median cross-vein, both forming part of the transverse cord; *pt*, ptero-stigma.

Spaniocerca tasmanica, n. sp.

♀. Length of body 11 mm., of forewing 10 mm., antennae 9 mm., cerci obsolescent. Head black, with occiput rich brown; antennae blackish. Thorax blackish; legs dark brown, with conspicuous black marks at both ends of femora and tibiae; tarsi blackish. Wings shining, semi-transparent, suffused with pale brown; hindwing markedly iridescent. Pterostigma of both wings conspicuous, long (about 3 mm.), brown. Somewhat hyaline areas present in forewing just distad from transverse cord and also on either side of basal half of Cu_1.

Types: Holotype female and allotype female (Mount Wellington, Tas., Jan. 31, 1917, R. J. T.), in Cawthron Institute collection, Nelson, N.Z.

REVISION OF THE AUSTRALIAN ELATERIDAE. COLEOPTERA.—Part I.

By Albert H. Elston, F.E.S.

[Read September 11, 1924.]

Family ELATERIDAE.

The insects comprising this family have the head sunk into the prothorax, almost up to the eyes, and it is always wider than long; the antennae are very variable in length, as long as the body or not even reaching the base of the pronotum, either filiform, serrated, combed, or even laminated and having either eleven or twelve joints; the upper lip is always visible, transverse or semicircular, and sometimes emarginate in the middle of the anterior margin; the maxillae are always small and bilobed, and at the apex with dense and somewhat long hairs; the maxillary palpi are always four-jointed; the basal joint is small, the following two variable in length, and the last one having different shapes, being either filiform, securiform, triangular or even cylindrical; the labial palpi are mostly short and three-jointed, the last joint, as with the maxilliary palpi, is of various shapes. The prosternum is elongate and, with one exception (Campylides), provided in front with a protuberance, generally rounded, projecting underneath the head, and frequently concealing the entire lower part; at the posterior end, the prosternum is abruptly contracted between the anterior legs and is prolonged into a projection, either straight or curved, which is received into a cavity in the mesosternum, and forming an important part of the curious mechanism which gives these insects the power of jumping or skipping, when they are placed on their backs. The scutellum is always visible, and the elytra are usually elongated. The legs are comparatively short and the tarsi five-jointed; the latter are either simple, more or less compressed, under surface clothed with hairs, sometimes very strongly dilated or flatly depressed, or the individual joints are bilobed, cordate or lobed.

The Elateridae in their larval stage are known as wireworms; they are distributed all over Australia and attack a variety of crops. They are particularly destructive to maize, wheat and oats, as well as to potatoes, sugar beets and sugar cane. When attacking the cereal and forage crops they work entirely beneath the surface of the ground, and their attention is chiefly confined to the seeds, roots and underground stems.

My work, up to the present, has been considerably lightened by the help of my colleagues in Australia generously loaning to me their collections, and I herewith desire to express my appreciation of the courtesy of the following gentlemen in this connection:—Mr. A. M. Lea of the South Australian Museum; Mr. J. Clark of Perth; Mr. H. J. Carter and Dr. E. W. Ferguson of Sydney; Mr. F. E. Wilson of Melbourne; Mr. J. C. Goudie of Maldon, Victoria; and Mr. R. F. Kemp of Adelaide.

Subfamily AGRYPNIDES.

The members of this subfamily have the mandibles dentate on the inside or cleft at the apex; the antennae seldom extend beyond the base of the pronotum and are received into the prosternal furrows formed by the separation of the lateral borders of the prosternum from the sides of the prothorax; the face is flat, or more or less depressed. The prosternum is sometimes provided

with deep furrows for the reception of the tarsi, of which the latter are either simple, clothed underneath with brush-like hairs, or sometimes one or two joints are lobed or dilated.

Key to the Genera of Agrypnides.

1.	The tarsi are simple	2
1*a*.	Joints 1 to 4 of the tarsi are strongly dilated, flatly depressed, and at apex emarginate	*Trieres*
1*b*.	Apex of first joint of tarsi strongly, the remainder less strongly, dilated	*Pseudolacon*
2.	The antennal furrows reach up to the anterior legs	3
2*a*.	The antennal furrows do not reach up to the anterior legs	5
3.	The 3rd joint of antennae is shorter than the 4th, or if quite as long, in this case at least narrower than the latter. The pronotum is more or less arched, the carina of the posterior angles extends upwards and parallel to the lateral margins	*Agrypnus*
5.	The antennae long and more or less pectinate	*Homoeolacon*
5*a*.	The antennae short and not pectinate	6
6.	Elytra at the base strongly contracted, on the shoulders obliquely truncate, the epipleurae not twice as long as wide	*Myrmodes*
6*a*.	Elytra at the shoulders rounded or angular, the epipleurae more than twice as long as wide	*Lacon*

Genus Lacon.

This genus has a world-wide distribution and is largely represented in Australia. It may be distinguished by the following characteristics: The mandibles are bifid or dentate on the inside; the apical joint of the palpi is securiform. The antennae are short, the first joint is large and somewhat bent, the second and third small, the third sometimes somewhat shorter than the second, the following are triangular, the last at the apex truncate or emarginate. The pronotum may be more or less flat or yet strongly arched, usually wider than long or as long as wide, and sometimes it may be even longer than wide; the appearance, at first glance, of the relative length and breadth of the pronotum is very deceptive, usually it will appear to be longer than wide, but on actual measurements it may prove to be only as long as wide or even slightly wider than long. The elytra are wide and comparatively short, at the sides parallel, or dilated in, or before, the middle; usually punctate-striate or with seriate punctures. The antennal furrows on the prosternum only reach to the middle; the sides of the pro- and metasternum have sometimes sharply defined or slightly distinct tarsal furrows; at the base of the propleurae there is frequently a deep transverse furrow for the reception of the anterior femur. The legs are moderately long, the femora and the tibiae usually of equal length. The insects comprising this genus may be divided into four sections. The first, having the pro- and metasternum furnished with deep, sharply defined tarsal furrows, as with *L. caliginosus*, Guer.; the second section, to which *L. socius*, Cand., belongs, has the prosternum only with deep, sharply defined tarsal furrows, and the metasternum with ill-defined furrows, or even entirely absent; the third has the pro- and metasternum, or the prosternum only, with distinct, but not deep and sharply defined tarsal furrows, of which *L. assus*, Cand., is an example; and the fourth section is without tarsal furrows on the prosternum, or, if present, so ill-defined as to be almost indiscernible, this last section is represented by *L. variabilis*, Cand.

Synonymy.

L. gayndahensis, Macl.=*L. assus*, Cand.
L. squalescens, Blackb.=*L. marmoratus*, Cand.
L. bimaculatus, Schwarz=*L. duplex*, Blackb.
L. adelaidae, Blackb.=*L. carinulatus*, Cand.

Lacon caliginosus, Guerin.

Hab.—New South Wales; Victoria; South Australia; Tasmania.

Lacon laticollis, Cand.

The posterior angles of the pronotum inside are lightly, but distinctly, carinate; a characteristic not mentioned by the author.

Hab.—Victoria; South Australia (Kangaroo Island); Western Australia.

Lacon ursulus, Cand.

This species is variable in size, specimens before me range from 9 mm. to 13·5 mm. in length.

Hab.—New South Wales; Victoria; South Australia.

Lacon socius, Cand.

A specimen from the Endeavour River, Queensland, agrees very well with the author's description of this species, and has the posterior angles of the pronotum rectangular. A specimen in the South Australian Museum, however, determined by Candeze as *socius,* has not the posterior angles of the pronotum rectangular. The latter specimen has the sides of the pronotum, in front of the posterior angles, lightly sinuated, and from the bottom of this sinuation are continued rectilinearly in an oblique direction downwards, which gives the angles the appearance of being widely and obliquely truncated. The interstices on the elytra have two rows of punctures, much smaller than those in the striae, very distinct near the base and in the middle, but almost obsolete on the posterior third.

Lacon farinensis, Blackb.

Hab.—South Australia (Parachilna); New South Wales (Broken Hill).

Lacon mansuetus, Blackb.

This species is very variable in colour, ranging from a dark brownish-black to a tawny tint. The pronotum has two more or less distinct subbasal round foveae, situated one on each side of the faintly defined longitudinal median furrow, midway between the latter and the lateral margins. In general appearance it closely resembles *L. granulatus,* Macl., but can be easily distinguished from that species by the base of the pronotum being much less deeply emarginate, the posterior part of the elytra more widely rounded, the punctures on the pronotum larger and not granulated in appearance.

Lacon assus, Cand.

L. gayndahensis, Macl.

Macleay's species is undoubtedly conspecific with *assus,* and must now be regarded as a synonym of the latter. The author in his description of *gayndahensis* said that the prothorax is "longer than the width," but this is so only in appearance; by careful measurement the width proves to be barely greater than the length. Some specimens have the tuberculate prominence within the posterior angles of the pronotum more conspicuous than on others, whilst on some it is barely discernible. Length, 13 mm. to 16·5 mm.

Hab.—Queensland; New South Wales.

Lacon costipennis, Germ.

This species is very variable both in colour and size, the former ranges from a dark brown to a tawny colour, on some specimens the pronotum is dark brown and the elytra a reddish-brown, also in many instances the posterior angles of the pronotum are reddish; when abraded this insect has a distinct nitid appearance. The size varies from 6·5 mm. to 10·25 mm. in length.

Hab.—Victoria; South Australia; Kangaroo Island; Western Australia.

LACON LACRYMOSUS, Cand.

Some specimens are much paler than the typical form, being of a reddish-brown, although probably this may be due to immaturity. On fresh specimens the clothing is slightly of a mottled appearance, due to whitish scales being interspersed among the dark ones, especially is this noticeable on the pronotum and the elongate tubercles on the posterior part of the elytra. The posterior angles of the pronotum, on many specimens, are of a distinct reddish colour. This insect, as with *L. costipennis*, Germ., to which it is closely allied, has a nitid appearance when abraded. The length varies from 5·5 mm. to 7·5 mm.

Hab.—South Australia.

LACON LINDENSIS, Blackb.

This species is very close to *L. lacrymosus*, Cand., and of which, probably, it is only a variety.

LACON GUTTATUS, Cand.

Closely allied to *L. pictipennis*, Cand., and of which, probably, it is only a variety. The size varies from 6 mm. to 8 mm. in length.

Hab.—Victoria; South Australia.

LACON MURRAYENSIS, Blackb.

The only distinction, apparently, between this species and *L. guttatus*, Cand., and *L. pictipennis*, Cand., is that of its colour. For the present I am regarding these as three separate species, although I believe eventually they will prove to be but one variable species.

LACON PORRIGINOSUS, Cand.

The author in his description of this species does not mention anything about the puncturation of the interstices on the elytra. The specimens determined by me as *porriginosus* have the interstices strongly and closely punctured, the punctures being only slightly smaller than those in the striae. The colour is variable, some specimens being of a much lighter brown than others. The length varies from 8·5 mm. to 11 mm.

Hab.—North-west Australia; North Queensland.

LACON MARMORATUS, Cand.

L. squalescens, Blackb.

I have examined a cotype of *L. squalescens*, Blackb., which is in the South Australian Museum, and it is undoubtedly the above species, of which Mr. Lea has specimens in his collections determined by Candeze. It is a somewhat variable species, the colour of some being a much lighter brown than others; the longitudinal furrow on the pronotum is very finely impressed, whilst on several specimens it is almost obsolete. The length varies from 7·5 mm. to 10·5 mm.

Hab.—Queensland; New South Wales.

LACON VICTORIAE, Cand.

Hab.—Queensland; New South Wales; Victoria; South Australia; Tasmania.

LACON DUPLEX, Blackb.

L. bimaculatus, Schwarz.

The species described by Schwarz as *bimaculatus* is, apparently, the same as that described by Blackburn as *duplex;* the former must now be regarded as a synonym of the latter.

Hab.—New South Wales; Victoria; South Australia.

Lacon castelnaui, Cand.

The tarsal furrows on the prosternum are clearly indicated, but are neither deep nor sharply defined; those on the metasternum are almost obsolete.

Lacon sculptus, Cand.

Hab.—Queensland; New South Wales; Victoria.

Lacon divaricatus, Cand.

Hab.—Queensland; New South Wales; Victoria; South Australia.

Lacon granulatus, Macl.

On one specimen the dark scales on the pronotum are interspersed with whitish ones, and forming four more or less distinct maculae. The pronotum, by measurement, is about as long as wide and not "much longer than the width" as stated by the author, although, in appearance the length seems to be greater than the width. On the pronotum there are two small, shallow foveae, situated one on each side, and near to the almost obsolete longitudinal furrow, and just in front of the base. The antennae, anterior margins and posterior angles of the pronotum are more or less reddish. The prosternum has somewhat distinct tarsal furrows and those on the metasternum almost obsolete.

Lacon duboulayi, Cand.

The insect which I have determined as the above species differs from the typical form in size, its measurements being 19 mm. long and 7·5 mm. wide, and, in addition, a moderately wide, shallow, tarsal depression is distinctly visible on the prosternum; in all other respects it agrees very well with the author's description.

Lacon princeps, Cand.

Two specimens from Coen River, Queensland, are smaller than the typical form, one is only 20 mm. in length and the other 22 mm.

Lacon gibbus, Cand.

A specimen from the Northern Territory only measures 17·5 mm. in length.

Lacon crassus, Cand.

There is a single specimen before me from Queensland which agrees very well with the author's description, except that there is a more or less distinct, short, shallow tarsal depression on the prosternum.

Lacon variabilis, Cand.

This species, as its name implies, is indeed very variable, and is commonly distributed over the whole of Australia and Tasmania. On some specimens, particularly with the male, the tarsal depression is more or less visible, whilst on others it is entirely absent; the sculpture of the elytra also shows a certain amount of variability, the alternate interstices being more conspicuously elevated on some specimens than on others; the length varies from 7·5 mm. to 14·5 mm. A careful comparison of the type of *L. yilgarnensis*, Blackb., with a series of the above species would probably reveal it to be only a variety of *variabilis*, of which the latter, having a wide distribution, is variable *inter se*. The present location of the type of *yilgarnensis* is unknown to the author, who considers it desirable for the present that these two species should be considered as separate until such time that Blackburn's type can be examined. Apparently the only distinction

between these two insects is that *yilgarnensis* has the margins of the pronotum less flattened and the tarsal furrows on the prosternum more conspicuous.

LACON INCULTUS, Macl.

Hab.—North-west Australia; Northern Territory.

LACON PLEURETICUS, Cand.

This species has a moderately wide, shallow depression on the prosternum for the reception of the tarsi. On the inside of the posterior angles, close to the lateral margins, is a very fine, but nevertheless distinct, carina. The interstices of the elytra have each two rows of punctures, much finer than those in the striae, and the alternate striae are each more densely squamose than the others.

LACON VARIOLUS, Cand.

The tarsal furrows on the metasternum are almost as distinct as those on the prosternum. The interstices of the elytra near the suture are moderately wide and flat and, *inter se*, equal; towards the lateral margins they are more narrow and costate, the interstices near suture have each two rows of punctures, smaller than those in striae.

LACON GEMINATUS, Cand.

Specimens from King River, Northern Territory, agree very well with the author's description, except that they are much smaller and variable in size, the smallest being 10 mm., and the largest 13 mm., in length.

LACON CARINULATUS, Cand.

L. adelaidae, Blackb.

On a large number of specimens examined by me there are to be seen two more or less distinct round foveae on the pronotum, one on each side of the longitudinal furrow, just in front of the base, and about midway between the former and the lateral margins; a characteristic not mentioned by either of the above authors. The elytral sculpture of this insect varies considerably, on some forms the alternate interstices are more elevated than on others, agreeing well with what Candeze wrote, "les intervalles impairs élevés en forme de petites côtes nettement saillantes." In the series before me there are to be found also specimens agreeing with what Blackburn wrote about *adelaidae*, "the alternate interstices of its elytra by no means strongly carinate." The intermediate stages between these two forms are also before me, so that I feel convinced the insect described by Blackburn as *adelaidae* is the same species as that described by Candeze as *carinulatus*. The length varies from 5·75 mm. to 7·5 mm.

Hab.—South Australia; Victoria.

LACON PLAGIATUS, Cand.

There are a number of specimens before me which undoubtedly appear to be this species. The colour of the body, on both the dorsal and ventral surfaces, is dark brown, with the exception of the posterior angles of the pronotum, which are sometimes strongly diluted with red; the antennae and legs are testaceous, the latter somewhat darker than the former. The posterior angles of the pronotum are acute and with a more or less distinct, fine carina on each near the outer margin; the punctures in the striae are almost round, those of the interstices also round but smaller. Length, 7 mm. to 9·5 mm.; width, 2·5 mm. to 3·75 mm.

Hab.—North-west Australia (Derby); Northern Territory (Daly River); Queensland (Cairns, Coen River, Cunnamulla, Normanton, Stewart River); South Australia (Oodnadatta).

Lacon perplexus, n. sp.

Wide, moderately convex; subnitid; reddish-brown, pronotum and head slightly darker, antennae and epipleurae of elytra reddish; moderately thickly clothed with yellow squamose hairs. Head flat, with a small shallow depression near the top; punctures concealed by the clothing. Pronotum transversely gibbous behind the middle, wider than long, sides roundly contracted on the anterior third, thence straight to the base, which is subtruncate, posterior angles rectangular and very finely carinate; with closely placed, moderately large, sieve-like punctures, becoming smaller and more crowded near the margins. Scutellum almost round with a few large punctures. Elytra of the same width as pronotum at the base and barely twice its length, sides almost parallel to beyond the middle then roundly narrowed to apex, slightly flattened in the middle near suture; punctate-striate, the punctures in striae large and more or less oblong in shape, the interstices flat and very finely punctured. Prosternum with deep, sharply defined furrows for the reception of tarsi, metasternum with very shallow and wide depressions. Length, 10-14·5 mm.; width, 4·25-5·5 mm.

Hab.—North-west Australia: Forrest River (W. Crawshaw), Hammersley Range (W. D. Dodd), Wyndham (W. Crawshaw); Northern Territory: Port Darwin. Type in author's collection.

The longitudinal furrow on the posterior part of the pronotum is not quite deep enough to divide the transverse gibbosity; the punctures in the elytral striae are much larger near the lateral margins than elsewhere, and those on the interstices more distinct near the base. The specimen from Port Darwin differs from the typical form in being of a uniform dark brown. Very close to *L. socius*, Cand., but wider in proportion to length, more nitid, and with the punctures in the elytral striae larger. Distinguished from *L. incultus*, Macl., by being proportionately broader and with the interstices on the elytra wider.

Lacon impressicollis, n. sp.

Moderately flat and wide; of a uniform dark brown with the antennae, palpi, posterior angles of prothorax, scutellum, epipleurae of elytra and legs reddish; densely clothed with very small, light-brown scales. Under surface brown, diluted with red and less densely clothed than upper surface. Head moderately flat and lightly impressed in the middle near the top; with dense, not large, rugose punctures. Pronotum wider than long, the sides roundly contracted on the anterior third, thence straight to the base, which is subtruncate; posterior angles rectangular, and almost imperceptibly carinate, depressed inside the anterior and posterior angles; longitudinally impressed in the middle, and with two distinct, round subbasal depressions, one on each side of the longitudinal furrow; densely covered with moderately small, round punctures. Scutellum almost round, slightly convex, and minutely punctured. Elytra as wide as pronotum at the base and less than twice the length of the latter, sides straight and almost parallel to just beyond the middle, thence strongly, roundly narrowed to apex; somewhat flattened on top near the suture; punctate-striate, the punctures in striae moderately large and deep, the alternate interstices wider and more elevated, minutely punctured. Prosternum with moderately deep, but not sharply defined, tarsal furrows. Length, 6·75 8·5 mm.; width, 3-3·75 mm.

Hab.—Tasmania: George Town, Ben Lomond (4,000 feet). Type in South Australian Museum.

In form somewhat resembling *L. laticollis*, Cand., but with the pronotum less convex, the elytra sculptured differently, and the tarsal furrows on the prosternum not sharply defined. Allied to *L. sculptus*, Cand., but easily distinguished by the shape of its pronotum, the punctures of which are much smaller, the upper surface more densely covered with scales and with the sculpture of the elytra different.

Lacon validus, n. sp.

Thick, convex; subopaque; dark brown with the antennae (basal joint excepted), tibiae and tarsi reddish; moderately densely clothed with griseous-yellow, squamose hairs, on parts of elytra more thickly arranged and forming patches. Under surface same colour as upper, densely and uniformly clothed with very small pale scales. Head with surface very uneven and thickly covered with rather large punctures. Pronotum wider than long, transversely gibbose behind the middle, and with an indistinct longitudinal furrow posteriorly, sides roundly contracted on the anterior third and sinuate in front of the posterior angles, finely crenulate; posterior angles moderately large, slightly divergent, and widely and obliquely truncated, indistinctly carinate; impressed inside the anterior and posterior angles, the latter more deeply than the former; closely covered with rather large punctures, becoming smaller near the margins. Scutellum pentagonal, slightly concave and acuminate behind. Elytra as wide as pronotum and slightly more than twice its length, sides barely perceptibly dilated near the middle, then roundly contracted to apex; punctate-striate, the punctures in striae moderately large and almost round, the interstices wide and flat, each with two rows of punctures which are smaller and more shallow than those in striae. Prosternum and metasternum with wide, shallow tarsal depressions, those on the former much more distinct than those on the latter. Length, 13-15 mm.; width, 5-5·5 mm.

Hab.—Queensland: Bowen (A. Simson). Type in South Australian Museum.

The clothing is more patchy on the posterior part of the elytra than elsewhere and arranged so as to form two or three more or less distinct fasciae; the head has three or four large depressions which give its surface a very uneven appearance, also slightly granulated on the vertex; the interstices of the elytra are distinctly granulated near the base. Distinguished from *L. crassus*, Cand., by the patchy appearance of the clothing on the elytra, the uneven surface of the head, and the prosternum with distinct tarsal impressions.

Lacon productus, n. sp.

Elongate, moderately convex; subopaque; reddish-brown with the antennae, posterior angles of prothorax, scutellum and legs more reddish; moderately densely clothed with short, yellowish-grey, squamose hairs. Under surface somewhat paler than upper and similarly clothed. Head triangularly impressed in the middle, and with closely arranged, rather small punctures. Pronotum about as long as wide, sides roundly contracted on the anterior fourth, thence straight to the base which is subtruncate; transversely gibbose behind the middle and with the gibbosity feebly divided by a shallow longitudinal furrow which extends almost the whole length of the pronotum; posterior angles almost rectangular and very feebly carinate; with moderately dense, small, round punctures, smaller and more crowded near the sides. Scutellum vaguely pentagonal, more or less rounded posteriorly, slightly concave and feebly punctured. Elytra as wide as pronotum and about two and a half times as long, sides parallel to beyond the middle then roundly contracted to apex; punctate-striate, the inside striae with small round punctures, those of the outer ones

much larger and more or less quadratic, the interstices rather wide and flat, minutely punctured. Prosternum with shallow, but nevertheless distinct, tarsal depressions. Length, 9 mm.; width, 3 mm.

Hab.—Northern Territory: Darwin (W. K. Hunt). Type in South Australian Museum.

The clothing on the elytra is arranged in double rows on each of the interstices; the sides of the pronotum in front of the posterior angles are not at all sinuate. In general appearance somewhat resembling *L. caliginosus*, Guer., but smaller, more convex, and with the sculpture of the elytra and tarsal furrows different.

Lacon orthoderus, n. sp.

Elongate, narrow, convex; brown, in parts feebly diluted with red, the greater portion of head, antennae, and parts of the legs reddish; moderately densely clothed with pale griseous, acuminate scales. Under surface somewhat more reddish than above and similarly clothed. Head widely and somewhat deeply impressed in the middle, closely and rugosely punctured. Pronotum longer than wide, evenly convex, with a feeble, longitudinal, median furrow on the posterior half; sides on the anterior fourth roundly and feebly contracted, thence straight and parallel to the base, which is widely sinuate, lateral margins slightly crenulate; anterior and posterior angles lightly impressed on the inside, the latter subacute and produced backwards. Scutellum almost round, closely and finely punctured. Elytra as wide as pronotum and about twice the length, sides parallel to near the middle, then roundly contracted to apex; punctate-striate, the punctures in striae very dense and small, the interstices not wide, flat, and minutely punctured and granulate. Prosternum without tarsal depressions. Length, 7·5 mm.; width, 2 mm.

Hab.—Northern Territory (Blackburn's collection). Type in South Australian Museum.

The pronotum is evenly convex and not transversely gibbose, as is the case with most of the convex species of this genus; easily distinguished by the sculpture of the elytra. Near *L. productus*, Elston, but more slender, without tarsal depressions on the prosternum and the punctures smaller and more crowded.

Lacon scopulosus, n. sp.

Thick; subopaque; dark brown, with the antennae and legs a reddish-brown; moderately densely clothed with whitish-grey scales, on parts of the elytra somewhat more densely arranged and of a more whitish colour, which gives it a mottled appearance. Under surface same colour as above and moderately densely clothed with pale scales. Head almost semi-circular and flat with a shallow depression in the centre; closely punctured and distinctly granulated. Pronotum wider than long, transversely gibbose behind the middle, sides crenulate and abruptly contracted on the anterior third, thence straight to the base, which is almost straight; posterior angles subrectangular with the apex obliquely truncated; with small, closely arranged, subrugose punctures. Scutellum almost round and more or less concave. Elytra barely perceptibly wider than pronotum and about twice the length of the latter, evenly convex, sides very slightly dilated near the middle, then roundly contracted to apex; rather deeply punctate-striate, the interstices not wide, more or less flat, and on the basal half distinctly granulated. Prosternum with short, very indistinct, tarsal furrows. Length, 5-5·5 mm.; width, 2 mm.

Hab.—Queensland: Coen River (W. D. Dodd); Endeavour River. Type in South Australian Museum.

A small, thick, and very distinct species, with the clothing denser at the base and more patchy on the posterior part of elytra. The elytra, in parts, are

sometimes diluted with red and with the posterior angles of the pronotum more or less reddish; the sides of the pronotum in front are almost rectilinearly contracted and the longitudinal furrow in the middle, which is usually present on species of this genus, is absent. A smaller species than *L. pinguis*, Cand., the clothing different and with the posterior angles of the pronotum truncated.

Lacon adustus, n. sp.

Moderately thick; convex; subopaque; brown, in parts diluted with red, with antennae and legs reddish; rather densely clothed with tawny, squamose hairs, more densely arranged in parts and forming patches. Under surface convex; subnitid; reddish-brown and somewhat densely and evenly covered with testaceous squamose hairs. Head widely and rather deeply depressed in the middle; closely, deeply, and somewhat rugosely punctured. Pronotum wider than long, transversely gibbose behind the middle, more or less narrowly flattened inside the lateral margins which are crenulate; without a longitudinal furrow in the middle, sides somewhat abruptly contracted on the anterior third and from thence to the base almost straight, slightly sinuate in front of the posterior angles, which are widely and obliquely truncated on the outside, acuminate at the apex and carinate, the carina continued up to about the anterior third and forming a double edge; with moderately large, deep, and closely placed punctures, becoming smaller and somewhat more crowded near the margins. Scutellum pentagonal, acuminate behind and convex. Elytra slightly wider than base of pronotum and a little more than twice the length of the latter, evenly convex, sides somewhat dilated near the middle, then gradually and roundly contracted to apex; punctate-striate, the punctures in striae more or less rectangular, the interstices flat and even, minutely punctured and tuberculate near the base. Prosternum with shallow, more or less distinctly visible, tarsal furrows. Length, 8-12 mm.; width, 3-5 mm.

Hab.—Queensland: Cairns (A. M. Lea), Coen River, Stewart River (W. D. Dodd, Townsville (N. B. Tindale), Malanda (Dr. E. Mjöberg). Type in South Australian Museum.

On some specimens the epipleurae of the elytra are reddish; there is no longitudinal furrow on the middle of the pronotum, or at the most only barely perceptible on the basal part; the carina begins from the top of the truncation of the posterior angles of the pronotum and extends upwards to about the anterior third, forming a more or less distinct double margin. Five specimens (Cairns [2] and Malanda [3]) differ from the typical form by having the clothing much brighter; the squamose patches on the elytra are more or less golden and those on the prothorax silvery. In general appearance it closely resembles *L. marmoratus*, Cand., but distinguished from that species by not having the pronotum longitudinally furrowed in the middle, the interstices on the elytra more finely punctured and distinctly granulate near the base.

Lacon submarmoratus, n. sp.

Elongate; moderately convex; subopaque; ferruginous with blackish patches; antennae, posterior angles of pronotum, epipleurae and legs a clearer red; moderately densely clothed with testaceous squamose hairs, more densely arranged on parts of elytra and pronotum and forming patches. Under surface of a more uniform ferruginous and with clothing similar to upper surface but more densely arranged. Head almost circular, with a large flat depression in the centre; somewhat coarsely punctured, the punctures more or less concealed by the clothing. Pronotum slightly longer than wide, base narrower than width at the anterior third, from the latter place abruptly, strongly, and rectilinearly contracted to anterior margin, lateral margins behind almost straight, very

slightly sinuate in front of the posterior angles, which are widely and obliquely truncated; lateral margins inside rather widely flattened, the longitudinal furrow just barely visible on the posterior half; closely covered with moderately large round punctures. Elytra as wide as pronotum and about two and a half times as long, sides almost parallel from base to middle and from thence gradually, roundly contracted to apex; punctate-striate, the punctures in striae rather small and rectangular, but becoming larger towards lateral margins, the interstices almost flat and with minute punctures, which are concealed by the clothing, distinctly granulate on the basal third. Prosternum with shallow, not very distinctly defined tarsal depressions. Length, 9-11 mm.; width, 2·75-3·75 mm.

Hab.—Queensland: Cairns (A. M. Lea). Type in South Australian Museum.

The antennae are comparatively long, almost reaching to the base of the pronotum; the elytra are much attenuated posteriorly. The scales on the latter are arranged in longitudinal rows and in parts more densely placed so as to form patches, particularly on the posterior half; the clothing on the pronotum is also irregular and so arranged as to appear in parts like guttae. This species is very close to *L. marmoratus*, Cand., but more elongate, antennae longer, pronotum rectilinearly contracted in front, with the lateral margins not crenulate and more widely flattened inside, and with the tarsal furrows on the prosternum not so strongly and clearly impressed.

Lacon applanatus, n. sp.

Elongate; rather flat; subnitid; upper surface dark brown with the antennae, palpi, legs, and posterior angles of pronotum reddish; moderately densely clothed with minute testaceous scales, which are seriate on elytra. Under surface same colour as upper but with the gula more or less reddish and the abdomen in parts diluted with red; somewhat densely clothed with small testaceous scales, more conspicuous than those on the upper surface. Head with three large depressions; densely covered with very small rugose punctures. Pronotum about as long as wide, lightly convex, abruptly and almost rectilinearly contracted from about the anterior fourth to base, from thence straight to posterior angles, in front of the latter slightly sinuate, sides not crenulate, the longitudinal furrow rather vague, the posterior angles almost imperceptibly produced backwards, the outer margin curved and slightly rounded off at the apex, with a very fine, but nevertheless distinct, carina; closely covered with small, round punctures. Scutellum small, truncate in front and rounded behind, minutely and rugosely punctured. Elytra as wide as pronotum and a little more than twice as long, almost flat on the middle with a narrow margin at the sides gently sloping, lateral margins vaguely dilated near the middle, from the posterior third gradually and roundly contracted to apex; punctate-striate, the punctures in rows moderately large and round, the interstices with densely placed punctures, a little smaller than those in striae, the alternate ones slightly elevated. The tarsal furrows on prosternum are almost indiscernible. Length, 8-11 mm.; width, 2·5-3·5 mm.

Hab. Western Australia. Type in author's collection.

The pronotum of this species is much more nitid than the elytra, and on some specimens the latter has a narrow margin at the suture and the sides of a more or less reddish tint; the fifth interstice of the elytra is distinctly more elevated than the others. It differs from *L. monachus*, Cand., by not having the posterior angles of the pronotum acuminate, more nitid and more depressed.

Lacon conspiciendus, n. sp.

Moderately thick; subopaque; dark brown, with the antennae, palpi, and parts of the legs ferruginous; somewhat thickly clothed with short, acuminate,

testaceous scales. Face with a large, shallow, triangular depression in the middle, the apex of which touches the anterior margin of the pronotum; closely and somewhat rugosely punctured. Pronotum longer than wide, convex, sides curved and much constricted in front of the posterior angles, which are strongly produced backwards, obtusely pointed at the apex and distinctly carinate; median longitudinal line feebly marked, with two rather large, deep, round foveae in front of the middle, and two less distinct ones in front of the base, situated two on each side of the median line and midway between the latter and the lateral margins; closely covered with rather large and almost round punctures. Scutellum flat, more or less rounded posteriorly and lightly punctured in the middle. Elytra at the base much narrower than pronotum and less than twice the length of the latter, the sides at the anterior fifth abruptly dilated from the base, from thence to just beyond the middle almost parallel, then suddenly contracted to apex; the top, between the fifth suture on each elytron, slightly depressed; punctate-striate, the punctures in striae large and round, but becoming much smaller posteriorly; the interstices sparsely covered with minute punctures, which are concealed by the clothing, the fifth and seventh distinctly elevated, the remainder more or less flat. Prosternum without any distinct tarsal impressions. Length, 12-13·5 mm.; width, 4-4·5 mm.

Hab.—Northern Territory: King River. Type in South Australian Museum.

A very distinct and unlike any previously described species; it is easily distinguished by the unusual shape of the pronotum and elytra, the former by its strongly produced posterior angles and the two conspicuous foveae near the middle, and the latter by having the anterior fifth and the posterior third abruptly contracted.

Lacon commutabilis, n sp.

Moderately thick; subopaque; dark brown, with antennae and mouth parts a pale, and the legs a darker ferruginous; moderately densely clothed with pale, squamose hairs. Under surface more densely clothed, of the same colour as upper, and with shorter and more depressed scales. Face almost semicircular and slightly depressed on the anterior part; somewhat deeply and closely punctured. Pronotum about as wide as long, evenly convex, sides roundly contracted on the anterior third and from the middle gradually contracted to near base; posterior angles rather strongly divergent and produced backwards, obtusely pointed, finely carinate, the carina extended along the sides up to the base of the anterior angles and forming a more or less distinct double edge to the margins; the longitudinal median furrow almost obsolete, only on the posterior half barely visible; on the middle with rather closely placed, large, round punctures, but becoming smaller and denser towards margins. Scutellum truncate in front and rounded behind, slightly concave in the middle with a few moderately large punctures. Elytra at base barely as wide as pronotum between apices of posterior angles slightly depressed near suture, humeral angles rounded, sides almost straight and parallel to beyond middle then gradually and roundly contracted to apex; punctate-striate, the punctures in striae elongately rectangular, those in the striae near suture much smaller than those near lateral margins; interstices moderately wide and flat, minutely punctured and very finely transversely rugose. Prosternum without distinct tarsal furrows. Length, 14·5-18 mm.; width, 5-6·25 mm.

Hab.—Northern Territory: Port Darwin (W. K. Hunt, coll. of Dr. E. W. Ferguson); North-west Australia: Derby (W. D. Dodd), Noonkanbah (Dr. E Mjöberg). Type in author's collection.

This species is variable in size and with some the colour is a more reddish-brown than the typical form; the posterior angles of the pronotum are more or less reddish and at the apex are not sharply truncated but somewhat rounded.

Lacon arbitrarius, n. sp.

Not thick; subnitid; ferruginous, with the epipleurae and parts of the under surface paler; moderately densely clothed with short, pale, squamose hairs. Face almost flat with a small shallow depression near the centre and with small, densely arranged punctures. Pronotum about as wide as long, evenly convex, sides rounded, sinuate in front of the posterior angles, which are slightly divergent and produced backwards, acute and very finely carinate, the carina continued up to the anterior angles and forming a more or less distinct double margin; with round punctures, not large, less crowded in the middle than at the sides. Scutellum pentagonal, anterior margin lightly emarginate, posterior obtusely angled, middle concave with a few round punctures more or less concealed by the clothing. Elytra at base as wide as pronotum and a little more than twice as long, slightly flattened on top near suture, sides almost straight and parallel to beyond middle, then gradually roundly contracted to apex; punctate-striate, the punctures in striae moderately large, deep, and almost round, the interstices rather wide, flat, and minutely punctured. Tarsal furrows on prosternum very shallow. Length, 10·5-13·5 mm.; width, 3·5-4·5 mm.

Hab.—North-west Australia: Derby, Kimberley district (Dr. E. Mjöberg). Type in author's collection.

Two specimens are paler than the typical form and have the anterior margin of the pronotum, base of elytra, and margins of scutellum more or less infuscated. This species closely resembles *L. commutabilis*, Elston, from which it can be distinguished by its smaller size, punctures on pronotum more scattered and smaller and, chiefly, by the different shape of the posterior angles of the pronotum, which are much smaller and acute.

Lacon bigener, n. sp.

Moderately thick; not opaque; dark reddish-brown, with the antennae, posterior angles of pronotum and legs ferruginous; moderately densely clothed with acuminate, testaceous, squamose hairs. Under surface same colour as upper but with the epipleurae more or less reddish; rather densely clothed with short, depressed, testaceous, acuminate and squamose hairs. Surface of head somewhat uneven; deeply and closely punctured. Pronotum about as wide as long, rather strongly convex and transversely ridged behind the middle, the posterior half with a feebly impressed longitudinal furrow, sides on the anterior third roundly contracted, near the middle rather strongly curved and sinuate in front of the posterior angles, which are acute, slightly divergent and produced backwards, finely carinate, the carina continued upwards to beyond the middle and forming a more or less distinct double edge to the sides; with densely arranged, large, almost round punctures, becoming smaller towards the margins. Scutellum truncate in front, almost rounded behind, and with the lateral margins concave; with a few small punctures in the centre. Elytra as wide as pronotum and about twice as long, convex but flattened near suture, humeral angles obtusely pointed, sides near middle slightly dilated; punctate-striate, the punctures in rows moderately large, deep and almost round, the interstices rather narrow and almost flat, minutely punctured. Tarsal depressions on prosternum barely discernible. Length, 10-13 mm.; width, 4-4·75 mm.

Hab.—Northern Territory: Port Darwin (W. K. Hunt). Type in South Australian Museum.

The punctures in the first elytral stria are smaller than the others, the flattened surface on top extends on each side of the suture to the second stria. This species comes between *L. commutabilis*, Elston, and *L. arbitrarius*, Elston; it differs from the former, *inter alia*, by having the posterior angles of the pronotum smaller and more acute, and from the latter by the punctures on the pronotum being larger and more crowded.

NOTES ON AUSTRALIAN CRUSTACEA.
No. III.

By Herbert M. Hale.
(Contribution from the South Australian Museum.)

[Read September 11, 1924.]

ISOPODA-VALVIFERA from South Australia.

The number of species of this tribe listed as occurring in Australian waters is small, and very few have been recorded from our State. There is little doubt that many forms remain to be collected, for, as remarked by Dr. Collinge,[1] "There is no reason to suppose that the South Pacific and Antarctic regions are any poorer in genera and species than the North Pacific and Arctic regions, although few have yet been obtained from the former regions."

Species of five genera not hitherto noted from Australia are herein described. In the specific descriptions the seven visible or "free" segments of the peraeon are referred to as the first to seventh segments, and the appendages of these somites as peraeopods.

Group I. ASTACILLINEA.[2]

In 1882 Haswell described *Arcturus brevicornis,* from New South Wales, and *A. longicornis,* presumed to be from Tasmania; judging from Haswell's figure the former species should be referred to *Astacilla.* Four years later Beddard added *Arcturus abyssicola* from off North-eastern Australia, etc., and *A. oculatus,* which has been taken in New South Wales and Southern Victoria. Whitelegge, in 1904, described five species—*Arcturus simplicissimus, A. dentatus, A. alcicornis, A. nodosus,* and *A. serrulatus*—dredged by H.M.C.S. "Thetis" in New South Wales waters.

Family ASTACILLIDAE.

Key to Australian Genera.

a. Fourth free peraeon segment much longer than any of the others.
  b. First free peraeon segment not fused with cephalon. Pleon composed of two somites, with distinct articulation .. .. *Astacilla*
  bb. First free peraeon segment fused with cephalon. Pleon composed of one somite, the articulations fused.
    c. Antennae very stout, compressed. Anterior four peraeopods stout, flattened, fringed with strong setae .. .. *Parastacilla*
    cc. Antennae moderately stout. Anterior four peraeopods slender, fringed with long, fine hairs .. .. *Neastacilla*
aa. Fourth free peraeon segment not much longer than any of the others *Arcturus*

Parastacilla, n. gen.

Form much as in *Astacilla.* Second antennae raptorial, stout, compressed. Maxillipeds moderately wide, with five-jointed palp and large epipodite. First free peraeon segment fused with cephalon, the lateral parts expanded downwards and forwards and fused to the infero-lateral portion of the head. Anterior four pairs of peraeopods stout, flattened and armed with strong setae. Pleon unisegmentate, with indistinct indications of three fused sutures.

Type *P. truculenta,* n. sp.

(1) Cllnge., Journ. Linn. Soc., Zool., xxxiv., 1918, p. 71.

(2) Cllnge., *loc. cit.*

Key to Species.

a. Peraeon segments without large dorsal spines .. .. *truculenta*
aa. Third and fourth free peraeon segments each with a large dorsal spine *bakeri*

Parastacilla truculenta, n. sp.

Fig. 1.

♀. Cephalon subglobose, dorsally tumid; anterior margin deeply excavate, very slightly produced medianly. Eyes small, subtriangular. First antennae reaching to end of second article of peduncle of second antennae; basal article laterally dilated, second twice as long as third and equal in length to flagellum, which is slender, uniarticulate, and bears sensory appendages at the distal end only. Second antennae large, stout, compressed; first article of peduncle very small; second shorter than third, which is half as long as fourth; fifth article about one-fifth longer than fourth; flagellum short, less than one-third as long as the fifth peduncular segment. Outer lobe of first maxillae capped with nine strong spines and one weaker spine. Maxillipeds with pinnate marginal hairs;

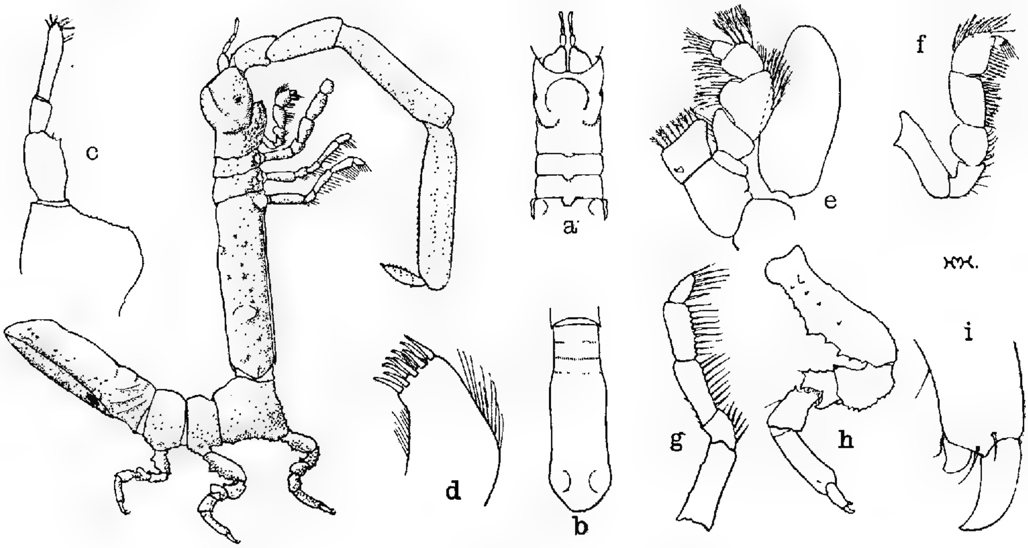

Fig. 1.

Parastacilla truculenta (4 diams.). *a*, Dorsal view of cephalon and first three peraeon segments (4¼ diams.); *b*, dorsal view of pleon (4¼ diams.); *c*, first antenna (20 diams.); *d*, outer lobe of first maxilla (40 diams.;) *e*, maxilliped (20 diams.); *f*, *g*, and *h*, first, fourth, and sixth peraeopods (10 diams.); *i*, terminal claws of fifth peraeopod (100 diams.).

palp not very elongate, composed of five articles; basipodite shorter than first three articles of palp together, the inner lobe short, not reaching to end of second article of palp and with a row of stiff, pinnate hairs on the almost straight distal margin; epipodite longer and wider than the palp. Peraeon cylindrical, the surface with some small and large scattered warts, and a few small conical spines. Anterior three segments each with a tubercle at middle of posterior margin. Infero-lateral margins of first reaching forwards almost to the level of the eye. Second and third segments subequal in length and fourth more than twice as long as first three together; fifth longer than sixth or seventh. First four pairs of peraeopods stout, flattened; first pair with curved, mostly pinnate or serrulate, marginal setae; second, third, and fourth pairs subequal in length, armed with strong, simple setae. Posterior three pairs prehensile, the last pair a little smaller than either of the others; basal joints armed with blunt, conical

spines; dactyli each with two strong, unequal, curved, apical claws, the smaller of which is less than one-third the length of its fellow. Pleon almost as long as fourth thoracic segment, obtusely-rounded apically; lateral margins tumid at the first third and again near posterior end; surface with small tubercles and a few larger protuberances; a dorsal swelling on each side near posterior marginal tumidities.

Colour, pinkish-brown with antennae and legs pale.

Length, 18·5 mm.

Hab.—South Australia: Beachport, 3-4 fms. (H. M. Hale). (Type, South Aust. Mus., Reg. No. C237.)

This species was dredged up with a mass of weed and was found clinging to a plant of the same colour as itself; it was in the position shown in the figure, clinging to the weed with the three posterior pairs of peraeopods.

Parastacilla bakeri, n. sp.

Fig. 2.

Cephalon subglobose, dorsally slightly and roundly elevated. Eyes of moderate size. First antennae reaching a little beyond termination of second article of second antennae; second article about one-fourth longer than third; flagellum rather broad, uniarticulate, more than twice as long as second and third

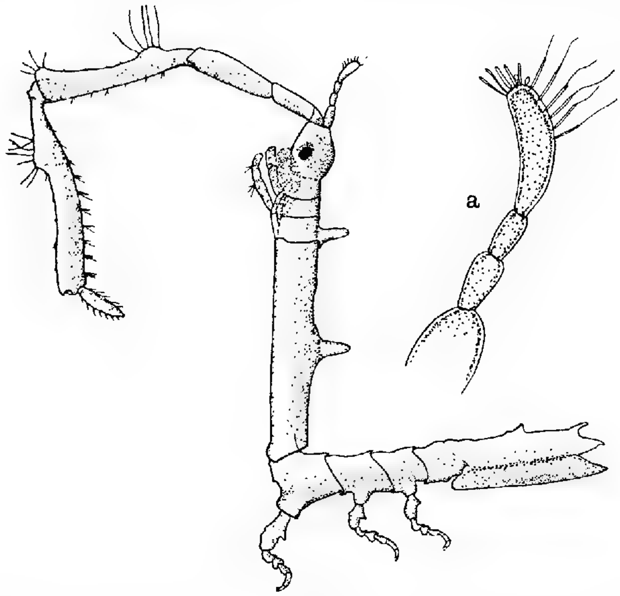

Fig. 2.
Parastacilla bakeri (9 diams.). *a,* First antenna (33 diams.).

peduncular joints together, and bearing sensory appendages on anterior half of margin. Second antennae large, stout; second article much shorter than third; fourth about one and two-third times as long as third, the dorsal margin elevated near posterior end and again at apex; fifth article one-third longer than fourth, the dorsal margin elevated at the first third of its length; each of the raised bosses is set with long hairs; flagellum short, one-fourth as long as fifth peduncular article. Fourth peraeon segment more than three times as long as first three together; dorsum of third segment with a large, blunt, spine-like projection; a similar projection at middle of length of fourth segment; fifth segment a little longer than sixth, which is longer than the seventh. Posterior three pairs of

peraeopods prehensile, the basos of each with a blunt spine and some smaller spines on inferior margin. Pleon considerably shorter than fourth thoracic segment; with a median, dorsal, conical projection just behind the middle of the length and with a backwardly-produced spine on each side of the mid-line near terminal end.

Length, 9·5 mm.

Hab.—South Australia: Marino Reef (W. H. Baker). (Type, South Aust. Mus., Reg. No. C238.)

Mr. Baker remarks that he found this species some years ago on a "pinkish weed," and that the crustacean was of the same colour when alive; like the foregoing species it was clinging with the posterior thoracic appendages, and carried that part of the body above the geniculation in an erect position. Only a single specimen was taken and, as it is mounted in balsam, it is not possible to accurately figure the legs and other appendages. The anterior peraeopods are crowded together and have become stained; nevertheless, it can be seen that they are stout, as in *P. truculenta.* There is no articulation between the head and first free thoracic segment and the abdomen is unisegmentate.

NEASTACILLA, Tattersall.

Neastacilla, Tatt., "Terra Nova," Zool., iii., 1921, p. 243.

This genus was erected for the reception of *Astacilla falclandica,* Ohlin, and *A. magellanica,* Ohlin. A South Australian species is now added.

Type, *A. falclandica,* Ohlin.

Neastacilla algensis, n. sp.

Fig. 3.

♀. Form slender. Cephalon elongate, much longer than its greatest width; dorsum with a prominent, conical tubercle between eyes; anterior margin deeply and evenly excavate. Eyes moderately large, subtriangular. First antennae reaching almost to posterior fourth of third article of second antennae; basal article stoutest; second stouter than third and equal to it in length; flagellum uniarticulate, with sensory appendages on distal half of margin. Second antennae

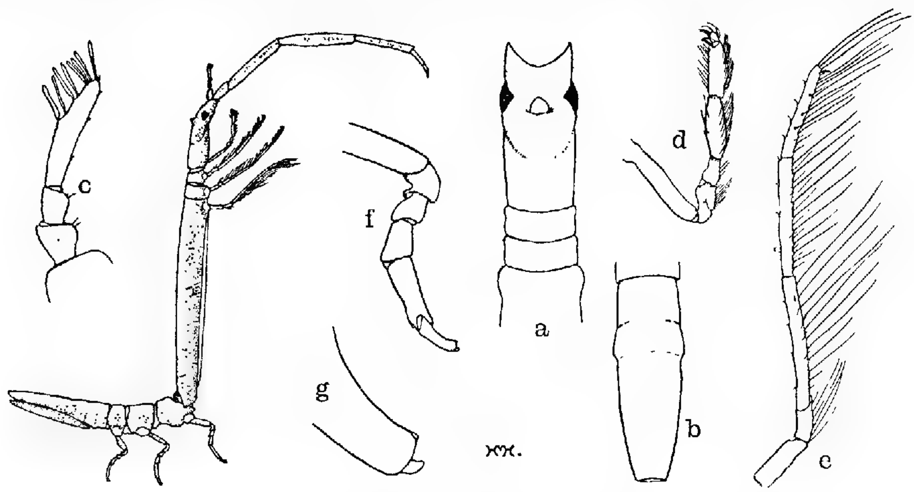

Fig. 3.

Neastacilla algensis (5 diams.). *a,* Dorsal view of cephalon and first three peraeon segments (10 diams.); *b,* dorsal view of pleon (10 diams.); *c,* first antenna (40 diams.); *d, e,* and *f,* first, fourth, and fifth peraeopods (20 diams.); *g,* terminal claws of fifth peraeopod (100 diams.).

subcylindrical, scarcely compressed; first article inconspicuous, not extending past anterior margin of head; second about half as long as head; third longer than fifth and very little shorter than fourth, which is longest; flagellum three-jointed, more than half as long as last article of peduncle. Palp of maxillipeds elongate, composed of five articles. Peraeon a little depressed, with a very obsolete, median, dorsal, longitudinal carina; surface almost smooth. First segment fused with the head; the infero-lateral margins forwardly produced but scarcely expanded downwards; second and third segments subequal in length, with antero-lateral angles prominent; fourth four times as long as first three together and five-twelfths of the total length of animal, exclusive of the antennae; fifth, sixth, and seventh segments decreasing in length backwards, the fifth being nearly twice as long as the seventh. Anterior four peraeopods slender; the first, and shortest, is furnished with fine fringing hairs and bears a flattened, subapical nail, which is serrate on the inner edge; second, third, and fourth appendages with long hairs on the inferior margins, and with the seventh joint represented by a slender nail; the second appendage is longer than the first and shorter than either third or fourth, which are subequal in length. Three posterior pairs somewhat feeble; dactylus of each with a small curved claw and a rudimentary second claw at apex. Pleon one-half as long as the fourth thoracic segment; unisegmentate with indications of two fused sutures, most distinct on sides; surface finely and sparsely punctate; lateral margins roundly prominent in the region of the second fused segment, thence a little curved and converging evenly to the truncate posterior margin.

Colour green, marked with tiny brown chromatophores; each uropod with a brown marking near base and another near apex. Thoracic appendages sub-hyaline.

Length, 12·25 mm.

Hab.—South Australia: Gulf St. Vincent, 6 miles west of Semaphore, 5-6 fms. (H. M. Hale). (Type, South Aust. Mus., Reg. No. C239.)

A single specimen taken on *Cymodocea antarctica* during a recent dredging excursion of the Field Naturalists' Section. The very long and slender fourth thoracic segment at once separates *N. algensis* from its congeners.

Group II. IDOTEINEA.[3]

The species previously recorded from Australia are listed below:—

Idotea metallica, Bosc, 1802.
,, *baltica*, Pallas, 1772.
,, *brevicorna*, M. Edwards, 1840, ? = *I. baltica.*
,, *margaritacea*, Dana, 1853, ? = *I. metallica.*
,, *excavata*, Haswell, 1882, ? = *Paridotea ungulata.*
,, *caudacuta*, Haswell, 1882 = *Euidotea peronii.*
Euidotea peronii, M. Edwards, 1840.
,, *stricta*, Dana, 1853.
Paridotea ungulata, Pallas, 1772.
,, ,, var. *atrovirens*, Collinge, 1918.
,, (? *Euidotea) bakeri*, Collinge, 1917.
Crabyzos longicaudatus, S. Bate, 1863.
,, *elongatus*, Miers, 1876.

No specimens of *Idotea* were found amongst South Australian material, although both *I. baltica* and *I. metallica* have a wide range. *Paridotea ungulata* and *Euidotea peronii* (which are also widely distributed) are the commonest of the species occurring on reefs and in shallow water off our coasts.

(3) Cllnge., *loc. cit.*

Family IDOTEIDAE.

Key to Australian Genera.

a. Palp of maxillipeds four-jointed.
  b. Pleon composed of three segments .. .. *Idotea*
  bb. Pleon composed of not more than two segments .. .. .. *Euidotea*
aa. Palp of maxillipeds five-jointed.
  c. Flagellum of second antennae well developed and multiarticulate.
    d. Coxal plates coalesced with peraeon segments.
      e. Palp of maxillipeds slender, with the fifth joint subequal in length to fourth; basipodite and epipodite small .. .. *Crabyzos*
      ee. Palp of maxillipeds broad, with the fifth joint very much shorter than the fourth; basipodite and epipodite large .. *Synischia*
    dd. Coxal plates free on second to seventh free peraeon segments.
      f. Pleon composed of three segments .. .. *Pentidotea*
      ff. Pleon composed of not more than two segments .. .. .. *Paridotea*
  cc. Flagellum of second antennae very short, formed of only one to three articles .. .. *Zenobiana*

EUIDOTEA, Collinge.

Euidotea, Cllnge., Journ. Linn. Soc., Zool., xxxiv., 1918, p. 84.

Type, *Idotea peronii*, M. Edwards.

The diagnosis of *Euidotea* was based upon a single species. It now becomes necessary to somewhat enlarge the limitations of the genus, but it may be noted that similar specific variation occurs in other genera of the family.

Key to Species.

a. Coxal plates large, those of seventh peraeon segment extending back beyond hinder margin of segment.
  b. Cephalon with a dorsal tubercle; peraeon longitudinally ridged .. *bakeri*
  bb. Cephalon not dorsally elevated; peraeon not longitudinally ridged .. *peronii*
aa. Coxal plates small, those of seventh peraeon segment not nearly reaching to hinder margin of segment .. .. *stricta*

EUIDOTEA PERONII, M. Edwards.

Idotea peronii, M. Edw., Hist. Nat. Crust., iii., 1840, p. 133; Chilton, Trans. N. Z'd. Inst., xxii., 1890, p. 199 (part).
Idotea distincta, Guér. Méneville, Icon. Règne Anim., 1829-1844, Crust., p. 33.
Idotea caudacuta, Hasw., Proc. Linn. Soc. N.S. Wales, vi., 1882, p. 181, pl. iv., fig. 4.
Paridotea peronii, Stebbing, Ann. S. Afr. Mus., vi., 1910, p. 433.
Euidotea peronii, Cllnge., *loc. cit.* (syn.).

Fig. 4, *e*, *f*, and *g*.

Common on South Australian coasts. As noted by Haswell the colour is extremely variable; in large examples the body is very convex and the posterior coxal plates are subtriangular in shape.

Collinge describes the pleon as "composed of a single segment and three lateral sutures." In a not inconsiderable series of South Australian specimens, the first suture is complete, thus marking off a short basal segment just as in the example figured by Miers [4]; the two segments are, however, not articulate. Chilton states that this suture is variable in *E. peronii* and *Paridotea ungulata*.

EUIDOTEA STRICTA, Dana.

Idotea stricta, Dana, U.S. Expl. Exped., xiv., Crust., ii., 1853, p. 704, pl. xlvi., fig. 7; Miers, Journ. Linn. Soc., Zool., xvi., 1881, p. 62.
Idotea peronii, Chilton, Trans. N. Z'd. Inst., xxii., 1890, p. 199 (part).

Fig. 4, *a*, *b*, *c*, and *d*.

This species superficially resembles *E. peronii*, but a comparison of examples of both forms, of the same size and sex, shows that *E. stricta* differs in the following characters:—

(4) Miers, Journ. Linn. Soc., Zool., xvi., 1881, pl. ii., fig. 6.

Form more elongate. Dorsum of cephalon roundly elevated. Flagellum of second antennae composed of a lesser number of articles. Coxal plates small, none of them reaching to the posterior margins of the peraeon segments. Pleon unisegmentate, with three pairs of short lateral sutures near base.

Hab.—New South Wales (Dana); South Australia: Gulf St. Vincent, 6-7 fms. (H. M. Hale), Kangaroo Island (W. H. Baker).

Chilton regards *E. stricta* as "specimens of *I. peronii* in which the two segments of the postabdomen have more or less completely coalesced." In describing *E. stricta*, however, Dana remarks: "Epimerals very small. . . . This narrow species has the epimerals occupying only part of the margin of each segment." In fig. 4 *(b* and *e)*, a female of *E. peronii* 15 mm. in length is drawn for comparison with an ovigerous female of *E. stricta* 15·5 mm. in length; in larger examples the difference in the relative size of the coxal plates is more marked. Even in specimens of *E. peronii* 6 mm. in length the last pair of coxal plates

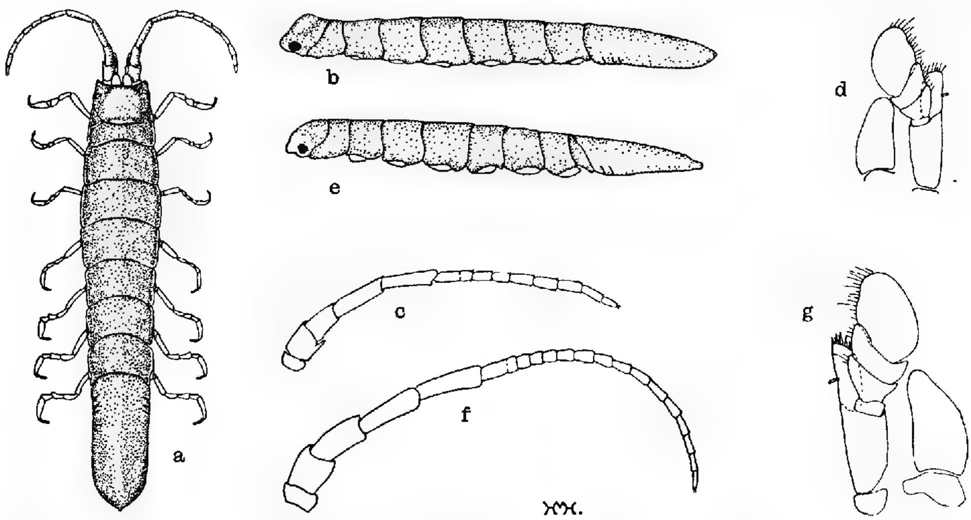

Fig. 4.

Euidotea stricta. *a*, Dorsal view (3½ diams.); *b*, lateral view (3½ diams.); *c*, second antenna (5 diams.); *d*, maxilliped (16 diams.). *Euidotea peronii.* *e*, lateral view (3½ diams.); *f*, second antenna (5 diams.); *g*, maxilliped (16 diams.).

extend back to the level of the hinder margin of the segment, but in an example of *E. stricta* 20 mm. in length they do not nearly reach to the posterior margin. The type of the species is approximately 22 mm. in length.

Euidotea bakeri, Collinge.

Paridotea bakeri, Cllnge., Journ. Zool. Research, ii., 1917, p. 112 (? part), pl. vi., figs. 1-3 and 6-8.

Fig. 5.

♂. Form moderately stout, four and one-half times as long as greatest width. Cephalon about twice as wide as long, narrower than the first peraeon segment, distinctly elevated dorsally and with a transverse groove near hinder margin; antero-lateral angles prominent; eyes of moderate size, situate dorso-laterally on slight elevations. First antennae reaching to middle of third peduncular article of second antennae; first article expanded; third about twice as long as second and subequal in length to the single-jointed flagellum. Second antennae stout and rather short, reaching to posterior margin of fourth peraeon segment; first article short, well visible in dorsal view; second and third subequal

in length, each stouter than, and more than one-half as long as fourth and fifth, which are subequal in length; flagellum shorter than peduncle, composed of seven articles and a minute terminal style; first and ultimate articles subequal in length and longer than any of the others; second to penultimate gradually increasing in length. Outer lobe of first maxillae capped with ten strong spines, four of the innermost of which are denticulate; inner lobe with three setose spines. Maxillipeds broad and stout, with four-jointed palp. Basipodite as long as terminal segment of palp; inner lobe moderately wide, with strong spines at distal end. Epipodite large, much longer than basipodite and first joint of palp together. Each peraeon segment strongly ridged on the longitudinal, median line, and with an oblique elevation, followed by a depression, midway between mid-line and lateral margins on each side. First segment a very little wider anteriorly than posteriorly; laterally forwardly produced to surround the posterior half of the head; anterior edges of lateral portions obliquely truncate; length at sides more than twice medial length. Second to sixth segments of equal length. First and seventh segments subequal in medial length, not much more than one-half as long as any of the others. Coxal plates of second to seventh segments

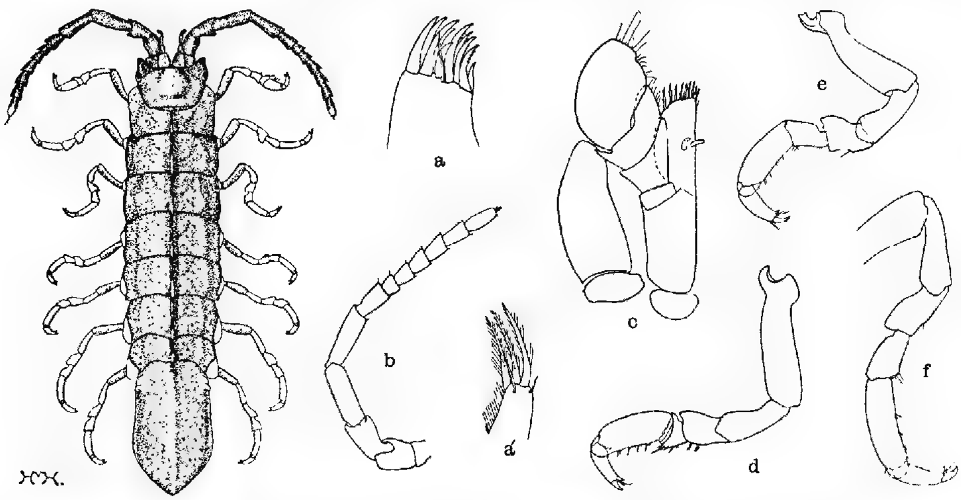

Fig. 5.

Euidotea bakeri (5 diams.). *a*, Terminal part of outer lobe and *(a')* of inner lobe of first maxilla (60 diams.); *b*, second antenna (8 diams.); *c*, maxilliped (32 diams.); *d*, *e*, and *f*. first, fourth, and seventh peraeopods (16 diams.).

conspicuous in dorsal view, none of them extending along the whole length of its segment; those of second to fourth small, rounded and placed in advance of the middle of the lateral margins of their segments; fifth to seventh increasing in size backwards; the fifth do not reach to the posterior margin of their segment; the sixth extend almost to the posterior margin; while the seventh pair are lobular, and reach back beyond the hinder edge of the segment. Anterior margin of each sternal segment with a row of rugose tubercles. Peraeopods slender. Pleon wide, with a longitudinal, median carina; unisegmentate, with three pairs of lateral sutures near base; lateral margins gently concave for anterior half, thence rounded and suddenly converging to the obtusely angular apex. Uropoda moderately elongate; endopodite narrowly and obliquely subtruncate at apex.

Colour pinkish-brown, with a black median stripe on peraeon; peraeopods yellowish, excepting on basos; antennae yellow on distal half of ultimate segment. Underside paler.

Length, 11 mm.

Hab.—South Australia: "Adelaide" (type loc.), Kangaroo Island, Marino Reef (H. M. Hale), Port Willunga Reef (S. S. Stokes).

An example 7 mm. in length is much darker in colouration, being almost black above and sooty beneath; in this specimen the flagellum of the second antennae consists of four articles and a terminal style. In the largest available male (21 mm.) the flagellum is eleven-jointed, and in a female of the same size is ten-jointed. The lateral sutures of the pleon are situated very close to the base, and the first, or anterior pair, is partly hidden by the posterior coxal plates.

As in *E. peronii,* the seventh coxal plates reach beyond the hinder angles of the last peraeon segment, but they are rounded and not apically angulate; the stouter maxillipeds and antennae, and the sculpture of the dorsal surface further distinguish *E. bakeri* from the last-named species.

I had previously described and figured this species in MS. as a new member of the genus *Euidotea*, not connecting it with *Paridotea.* Since the MS. was sent to press I received, through the courtesy of Dr. Collinge, the paper quoted above, and have made some tentative alterations in the nomenclature, but have let the descriptive details, as given above, stand. The specimens now described approximate very closely to Collinge's description of *Paridotea bakeri,* excepting as regards the maxillae and maxillipeds, which are very different; I venture to suggest that a re-examination of the type specimens may show that the mouth parts described for them belong to another species.

CRABYZOS, Spence Bate.

Crabyzos, S. Bate, Proc. Zool. Soc., 1863, p. 504; Cllngc., Journ. Linn. Soc., Zool., xxxiv., 1918, p. 71.

Type, *C. longicaudatus,* S. Bate.

In this well-defined genus the cephalon is usually partly fused with the first "free" peraeon segment. The coxal plates are coalesced in all the segments, and the coxopodites are well developed beneath, forming sockets in which the basos of the peraeopods articulates.

The form, at least in the male, is very elongate, and the mouth parts and uropods are correspondingly long and narrow. The terminal joint of the maxillipeds is relatively longer than in other genera of the family with five-jointed palp, while the basipodite and epipodite are small.

Collinge points out that *Idotea elongata,* Miers, should be referred to *Crabyzos;* this author[5] also mentions that he has examined two new species from South Australia, and promises a revision of the genus.

Key to Species.

a. Pleon acuminate at apex .. .. *longicaudatus*
aa. Pleon incised at apex .. .. *elongatus*

CRABYZOS LONGICAUDATUS, Spence Bate.

Crabyzos longicaudatus, S. Bate, *loc. cit.,* p. 504, pl. xli., fig. 7; Hasw., Cat. Austr. Crust., 1882, p. 278.

Idotea longicaudata, Miers, Journ. Linn. Soc., Zool., xvi., 1883, p. 63; Hasw., Proc. Linn. Soc. N.S. Wales, ix., 1885, p. 1001.

Fig. 6.

This species is moderately common amongst the "sea-grasses" growing in 3 to 6 fathoms in Gulf St. Vincent; the crustacean admirably matches the green leaves of the weed in colour.

Specimens before me differ from Spence Bate's figure in that the first antennae do not quite reach to the distal end of the third article of the second

(5) Cllnge., *loc. cit.*

antennae, and the first peraeopods are not markedly longer than the last pair. The first pair are long, and stouter than any of the others; the second to fourth

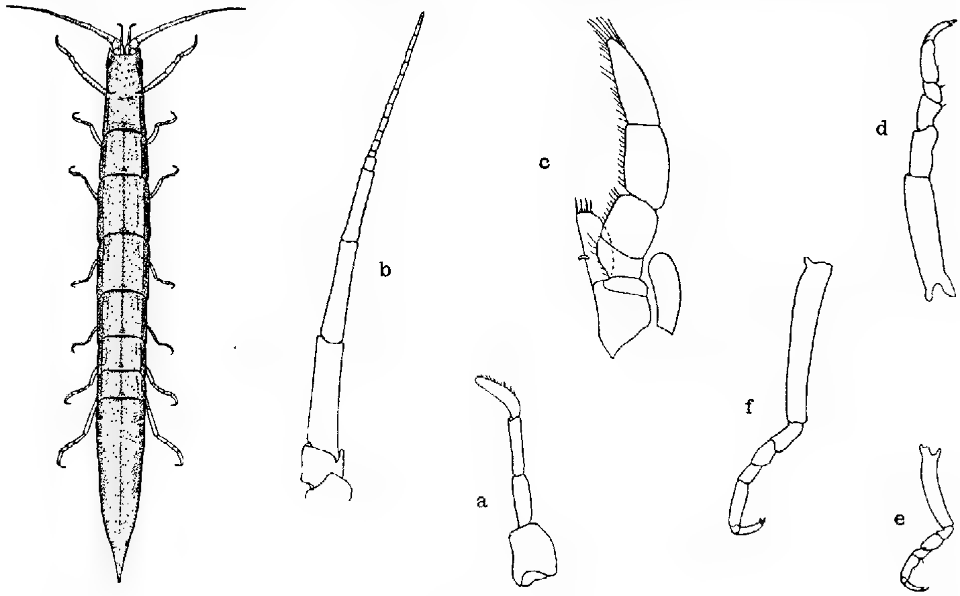

Fig. 6.

Crabyzos longicaudatus (1⅗ diams.). *a*, First antenna (8 diams.); *b*, second antenna (5 diams.); *c*, maxilliped (16 diams.); *d*, *e*, and *f*, first, fourth, and seventh peraeopods (5 diams.).

decrease rapidly in size, the fourth pair being scarcely more than one-half as long as the first; the remaining pairs increase in length posteriorly. In the seventh pair the basos is very long and the total length of these peraeopods is slightly greater than that of the first pair.

The dorsum of the peraeon is but slightly convex transversely, and the pleura form almost a right angle with the back. The pleon is unisegmentate, with faint indications of two pairs of lateral sutures.

The example figured above is an ovigerous female 49 mm. in length; in smaller specimens the peraeon is scarcely wider than the head, with the sides subparallel, and the pleon is more acuminate.

Hab.—South Australia: Gulf St. Vincent.

Crabyzos elongatus, Miers.

Idotea elongata, Miers, Ann. Mag. Nat. Hist. (4), xvii., 1876, p. 225; Chilton, Trans. N. Z'd. Inst., xxii., 1889, p. 198 (syn.).

Crabyzos elongatus, Cllngc., Journ. Zool. Research, i., 1916, p. 119.

Hab. -New Zealand; South Australia (*fide* Collinge, *ut supra*).

Synischia, n. gen.

Form narrow, flattened. Flagellum of second antennae slender, multiarticulate. Maxillipeds stout, with five-jointed palp, the last joint small; basipodite and epipodite large. Peraeon with a longitudinal, median ridge; all coxal plates perfectly fused with their segments. Pleon composed of a single segment, and with three pairs of short lateral sutures near base.

Type, *S. levidensis*, n. sp.

This genus differs from *Crabyzos* in the very different form of the maxillipeds, in the subhorizontal pleura of the peraeon segments and in having three pairs of distinct lateral sutures on the pleon.

Two other Idoteid genera, *Edotea*, Guérin Méneville and *Synidotea*, Harger, have the coxal plates perfectly united with the peraeon segments. Both of these genera differ from *Synischia* in having the palp of the maxillipeds three-jointed.

Synischia levidensis, n. sp.

Fig. 7.

♂. Form slender, six times longer than greatest width. Cephalon short and flat, not very convex dorsally; nearly twice as wide as medial length and distinctly narrower than the first peraeon segment; anterior margin concave; lateral margins slightly converging anteriorly. Eyes moderately large, situated dorso-laterally, and completely visible in dorsal view. First antennae reaching beyond second article of second antennae; basal joint expanded, longer than third, which is longer than the second, and subequal in length to the single-jointed flagellum. Second antennae slender, reaching back almost to posterior margin of fourth peraeon segment; first article short, visible in dorsal view; second and

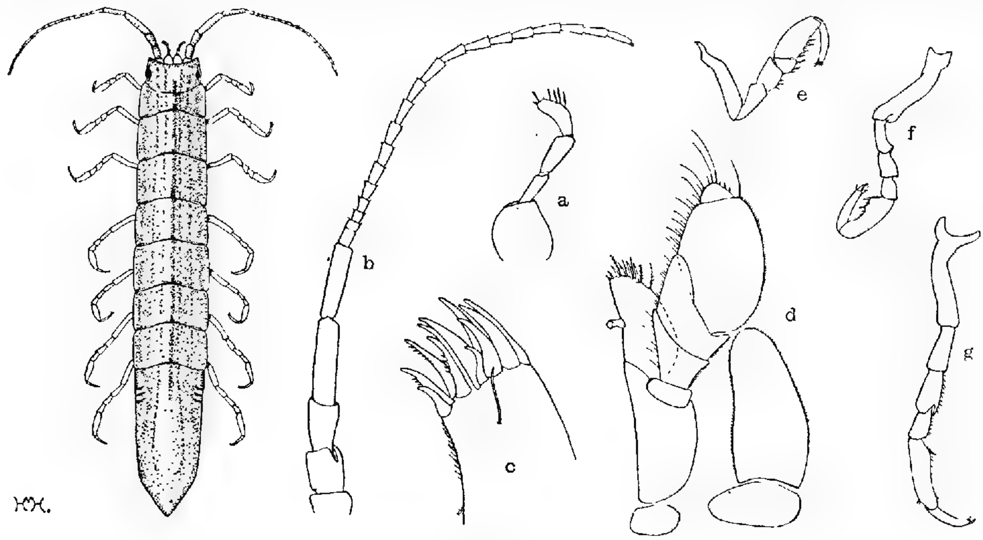

Fig. 7.

Synischia levidensis (3 diams.). *a*, First antenna (16 diams.); *b*, second antenna (8 diams.); *c*, terminal part of outer lobe of first maxilla (80 diams.); *d*, maxilliped (32 diams.); *e*, *f*, and *g*, first, fourth, and seventh peraeopods (8 diams.).

third subequal, together equal in length to fourth, which is longer than the fifth article; flagellum about one-half as long again as peduncle, composed of eighteen articles and a minute terminal style. Outer lobe of first maxilla capped with eleven strong spines, three of the innermost being denticulate. Maxillipeds broad, with five-jointed palp; basipodite stout, a little shorter than the epipodite; distal end of inner lobe with six strong, simple spines and some longer, slender, pinnate spines. Dorsum of peraeon roof-shaped, longitudinally medianly ridged, widest at last segment; first segment medianly short, distinctly less than half as long as second to fifth segments, which are equal in length; sixth and seventh of equal length, a little shorter than second to fifth segments. Coxal plates all fused with their segments, the junction being indicated by faint and indistinct depressions. Peraeopods rather feeble, increasing in length posteriorly, the first pair shortest. Pleon about as long as first four peraeon segments together, with a

longitudinal, median ridge on anterior fourth of its length, the remainder obsoletely carinate; composed of one segment, and with three pairs of lateral sutures; widest on anterior margin and with lateral margins slightly converging posteriorly for three-fourths of their length, thence suddenly converging to the acute apex. Uropoda narrow, with posterior margin truncate; endopodite apically narrowly rounded, subtruncate.

Colour very pale brown, speckled and longitudinally streaked with darker brown. Cephalon with a black, submarginal streak passing through each eye.

Length, 21 mm.

Hab.—South Australia: Gulf St. Vincent, 6 miles north-west of Outer Harbour, 6-7 fms. (H. M. Hale). (Type, South Aust. Mus., Reg. No. C242.)

A single specimen dredged from amongst *Cymodocea.*

PENTIDOTEA, Richardson.

Pentidotea, Richardson, Bull. U.S. Nat. Mus., liv., 1905, p. 368.

Type, *Idotea resecata,* Stimpson.

Pentidotea australis, n. sp.

Fig. 8.

♂. Form narrow, elongate, about six and one-half times as long as greatest width. Dorsum very convex. Surface smooth. Cephalon wider than long, much narrower than first peraeon segment; anterior margin almost straight in middle portion, very slightly convexly sinuate, laterally produced obliquely forwards to the angularly rounded antero lateral angles. Eyes moderately large, well visible in dorsal view. Peduncle of first antennae reaching to end of second

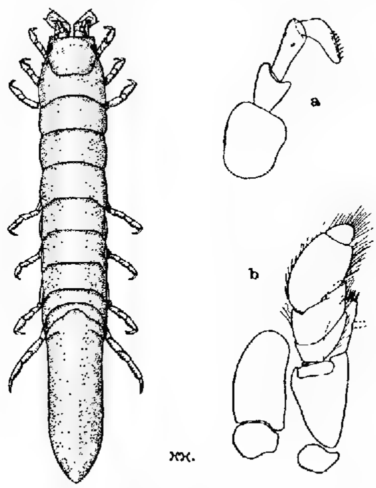

Fig. 8.
Pentidotea australis (1 1-10th diams.).
a, First antenna (6 diams.); *b,* maxilliped (6 diams.).

article of second antennae; first article large and dilated, a little longer than its greatest width; second article much wider and shorter than third, which is a little shorter than the first; flagellum subequal in length to last peduncular article. First article of peduncle of second antennae visible in dorsal view, one-half as long as second article, which is longer than the third; remainder missing. Maxillipeds with five-jointed palp; basipodite subequal in length to the epipodite inner lobe with some strong, simple spines at distal end. First peraeon

segment much narrower anteriorly than posteriorly, the lateral margins roundly converging; antero-lateral angles forwardly produced, surrounding the posterior part of the head to the level of the eyes; the medial length of this segment is much less than that of any of the others; second to sixth segments subequal in length; seventh a little shorter. Coxal plates in second and third segments elongate, less than half the length of the lateral margin; in the fourth about half the length of lateral margin; in the fifth, sixth, and seventh segments they are wider, slightly visible in dorsal view and almost as long as the lateral margins. Peraeopods strong, the anterior three pairs directed forwards, the others backwards; first pair stouter than second, third, or fourth, which are subequal in length; posterior three pairs successively increasing in size backwards, the seventh pair being one-third the length of the animal. Pleon as long as the first six peraeon segments together; first segment medianly longer than second; lateral margins of terminal segment subparallel for anterior two-thirds, thence narrowly converging to the subacute apex. Uropoda long and narrow; endopodite emarginate at apex.

Colour completely bleached after long preservation in alcohol.

Length, 51 mm.

Hab.—South Australia: Kangaroo Island. (Type, South Aust. Mus., Reg. No. C234.)

A single, mutilated specimen with the mouth parts of one side missing. The narrow, elongate form is distinctive for this species, which somewhat superficially resembles *P. rotundata*, Rich., from Japan. In the last-named species, however, the eyes are very small, the head is scarcely narrower than the first thoracic segment, the maxillipeds are different, and the abdomen is less narrowed posteriorly.

Paridotea, Stebbing.

Paridotea, Stebb., S. Afr. Crust., i., 1900, p. 52; Chilton, Subant. Is. N. Z'd., ii., 1909, p. 660; Barn., Ann. S. Afr. Mus., x., 1914, p. 424.

Type, *Idotea ungulata,* Pallas.

Key to Australian Species.

a. Third article of first antennae distinctly longer than second. Inner lobe of first maxillae capped with four setose spines. Anterior margin of endopodite of uropoda not, or scarcely, oblique .. .. *ungulata*

aa. Second and third articles of first antennae subequal in length. Inner lobe of first maxillae capped with three setose spines. Anterior margin of endopodite of uropoda distinctly oblique .. .. .. *munda*

Paridotea ungulata, Pallas.

Oniscus ungulatus, Pallas, Spicil. Zool., ix., 1772, p. 62, pl. iv., fig. 11.
Idotea lalandii, M. Edw., Hist. Nat. Crust., iii., 1840, p. 132, pl. xxxi., fig. 7.
Idotea affinis, M. Edw., *loc. cit.*, p. 133.
Idotea edwardsii, Guér.-Méneville, *loc. cit.*, p. 33.
Idotea nitida, Heller, Verhandl. Zool.-Bot. Ges. Wien, 1861, p. 497.
? *Idotea excavata,* Hasw., *loc. cit.*, p. 182.
Paridotea ungulata, Stebb., *loc. cit.*, p. 53; Nierstrasz, Zool. Meded., iii., 1917, p. 113, figs.; Cllnge., Journ. Linn. Soc., Zool., xxxiv., 1918, p. 81 (syn.).

Fig. 9, *e* and *f*.

This widely distributed species is common in the shallow waters of South Australia.

Paridotea munda, n. sp.

Fig. 9, *a* to *d*.

♂. Form slender, more than five times longer than greatest width. Sides parallel, surface smooth and dull. Cephalon about one and three-fourths times wider than long, narrower than the first peraeon segment, evenly convex dorsally;

anterior margin sinuate, slightly incised medianly; antero-lateral angles not prominent; postero-lateral margins converging posteriorly; eyes moderately large, situate dorso-laterally, on slight elevations. First antennae reaching to middle of fourth peduncular article of second antennae; first article subglobose, longer than second or third (which are subequal in length), and as long as the single-jointed flagellum. Second antennae slender, reaching back to posterior margin of fourth peraeon segment; first article very short; second and third articles subequal in length, shorter than fourth and fifth, which are subequal in length; flagellum more than twice as long as peduncle, composed of twenty two articles and a terminal style. Outer lobe of first maxilla narrow, capped with nine strong spines; inner lobe with three setose spines. Maxillipeds elongate, with five-jointed palp. Basipodite as long as the two terminal segments of palp together; inner lobe narrow, with slender spines at distal end. Third joint of palp forwardly produced at inner apex. Epipodite narrow, very slightly curved inwards apically; longer than the basipodite and first joint of palp together. First peraeon segment widest anteriorly, where the pleura are

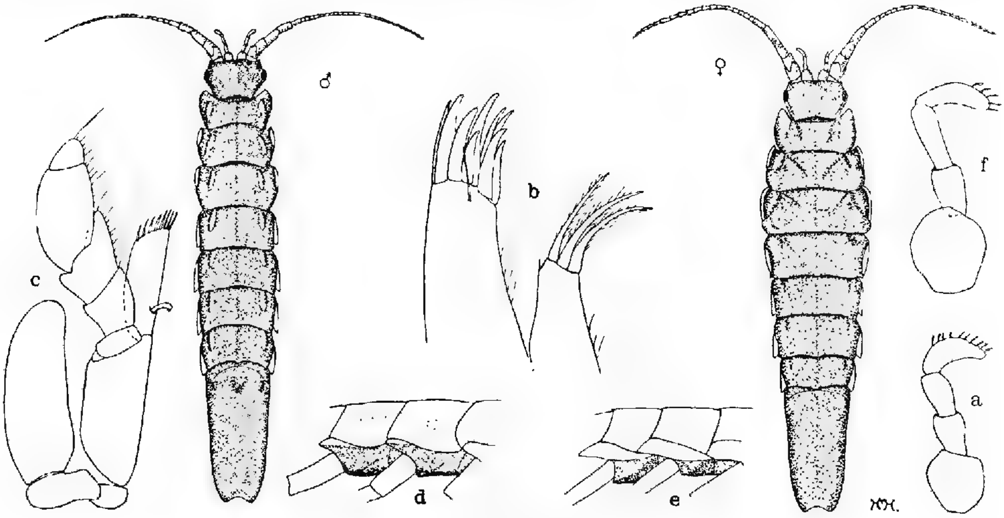

Fig. 9.

Paridotea munda, male (left) and female (right) (3½ diams.). *a*, First antenna (16 diams.); *b*, first maxilla (80 diams.); *c*, maxilliped (32 diams.); *d*, lateral view of sixth and seventh peraeon segments (5 diams.). *Paridotea ungulata*, *e*, lateral view of sixth and seventh peraeon segments (4 diams.); *f*, first antenna (16 diams.).

produced outwards and forwards, but do not embrace base of head; anterior and posterior margins concave. Second to seventh segments subequal in length, the second and last a little shorter than the others. Second segment slightly forwardly produced at anterior lateral angles, and with coxal plates occupying anterior half of lateral margins. Coxal plates of third segment rather more than one-half as long as lateral margins, of fourth almost as long as, of fifth equal in length to, and of last segment longer than, lateral margins. Peraeopods slender, without fur on inner margins. Pleon narrow, medial length about twice basal width; about one-half as long as peraeon; unisegmentate, with a very faint complete suture line near base, followed by two pairs of short, indistinct lateral sutures; gradually tapering from base to apex, which is evenly, concavely incised, with postero-lateral angles rounded. Uropoda narrow, posterior margin oblique; apex of endopodite truncate, a little concave.

Colour pinkish-brown, with a pale elongate spot, outlined in black, at each side of peraeon segments. A black streak extending from hinder edge of eye to base of cephalon. Antennae and peraeopods very pale yellowish, minutely dotted with brown. Uropoda with anterior half of inner margin bordered with black.

Length, 16 mm.

Ovigerous female. Second antennal flagellum composed of nineteen articles. Second to fifth segments of peraeon widened, the third the widest; antero-lateral portions of second to fourth segments tumid.

Colour yellowish-green, with a blackish marking on each side of peraeon segments. A black streak behind eye. Marsupial plates with a conspicuous black spot at base.

Length, 14·5 mm.

Hab.—South Australia: Marino Reef (type loc., H. M. Hale), Port Willunga (S. S. Stokes); Tasmania (A. M. Lea). (Type male, Reg. No. C249, and allotype female, C250, in South Australian Museum.)

Females without ova are narrow in form, and in this sex the pleura of the first peraeon segment occasionally partly embrace the base of the head. In a few specimens the pleon is much more deeply incised at the apex than in the type. The largest example available is 22 mm. in length.

This species may be separated from *P. ungulata* by the following characters:—The outer lobe of the first maxilla is narrower and is capped with a lesser number of spines, while the inner lobe bears only three setiferous spines; the epipodite of the maxillipeds is of different shape. The coxal plates, when viewed laterally *(cf.* fig. 9, *d* and *e)*, are different, and the articles of the first antennae are of different proportions (fig. 9, *a* and *f)*. In *P. ungulata* the apical notch of the pleon is broadly angulate or sinuate, with acute postero-lateral angles. *P. munda* is apparently allied to *P. fucicola*, Barn., from South Africa, but in the last-named species the fourth to seventh peraeopods have "thick fur on inner margin of fourth to sixth joints."[6] Barnard's figure shows that in *P. fucicola* the head is not narrower than the first peraeon segment and the terminal notch of the pleon is very small, while the mouth parts, which are figured by Collinge,[7] are somewhat different.

ZENOBIANA, Stebbing.

Zenobia, Risso, Hist. Nat. de l'Europe Mérid., v., 1826, p. 110.
Cleantis, Dana, Amer. Journ. Sci. and Arts (2), viii., 1849, p. 427.
Zenobiana, Stebbing, Ann. Mag. Nat. Hist. (6), xv., 1895, p. 24; Cllnge., Trans. Roy. Soc., Edinburgh, li., 1917, p. 749 (syn.).

Type, *Zenobia prismatica*, Risso.

Zenobiana phryganea, n. sp.

Fig. 10.

♂. Form narrow, elongate, nearly six times as long as greatest width; surface of head and thorax obscurely pitted and scratched; surface of abdomen with shallow but distinct pits. Width of cephalon one-half as long again as medial length; width at anterior margin equal to that at base; anterior margin slightly concave, posterior margin convex; eyes moderately large, situated dorso-laterally. First antennae stout, very short, extending a little beyond second

(6) Barn., Ann. S. Afr. Mus., x., 1914, p. 427, pl. xxxvi. E.

(7) Cllnge., *loc. cit.*, p. 84, pl. viii., figs. 30, 31.

article of second antennae; basal article stout, longer than wide; second and third subequal in length, together as long as the first; flagellum wide, apically rounded, longer than second or third peduncular articles. Second antennae short, not as long as head and first two thoracic segments together; first article small, and fifth a little longer than second or fourth, which are subequal in length; third article considerably shorter than second; flagellum composed of one article, tapering, scarcely longer than last article of peduncle. Maxillipeds moderately elongate, with five-jointed palp; basipodite scarcely longer than the first three articles of palp together, the inner lobe with some curved, pinnate spines at distal end; epipodite large, narrowed towards apex. Sides of peraeon parallel; first segment medianly the shortest, a little shorter than the second; fourth, fifth, and sixth segments subequal in length, longer than second, third, or seventh

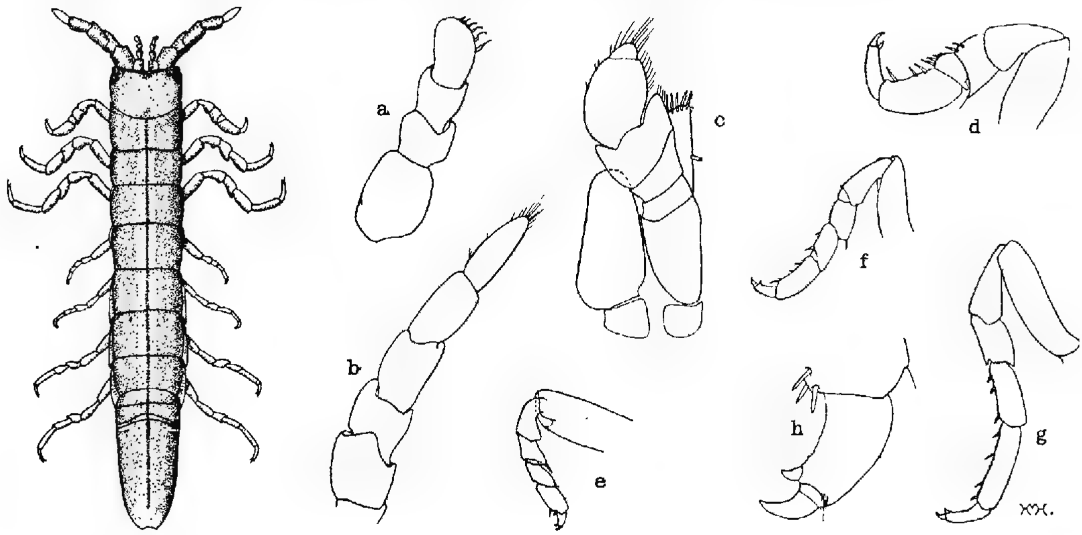

Fig. 10.

Zenobiana phryganea (5 diams.). *a*, First antenna (30 diams.); *b*, second antenna (15 diams.); *c*, maxilliped (30 diams.); *d*, *e*, *f*, and *g*, first, fourth, fifth, and seventh peraeopods (15 diams.); *h*, dactylus of fifth peraeopod (75 diams.).

segments. Coxal plates of second to fourth segments small, much shorter than the lateral margin of the segments; those of fifth to seventh larger and longer, extending back to well beyond posterior margins of the segments. Anterior three pairs of peraeopods stout, successively increasing in length backwards; last four pairs much more slender, increasing in length backwards, the fourth being much shorter than the first pair, and only about half the length of the seventh. Pleon composed of four segments and a single pair of short lateral grooves denoting a partly fused segment; first segment longer than second, which is twice as long as the very short third; terminal segment more than three times as long as first three segments together; lateral margins slightly converging for anterior half, thence roundly converging to the somewhat narrow apex, which is emarginate. Uropoda narrow; endopodite apically rounded, subacute.

Colour brown, with indistinct paler vermiculations; a median, longitudinal line on peraeon and greater part of length of pleon, and lateral edges of thoracic segments, sooty; a pale stripe on each side of mid-line of peraeon. Coxal plates, legs, apex of abdomen, and flagellum of both first and second antennae pale yellow. Underside pale brown. Uropoda yellow, with brown markings.

Length, 11 mm.

Hab.—South Australia: Marino Reef (W. H. Baker and H. M. Hale). (Type, South Aust. Mus., Reg. No. C235.)

In a specimen 8 mm. in length the abdomen is relatively less narrowed posteriorly.

This species approaches *Z. granulosa*, Heller, and *Z. tubicola*, Thomson, in that the extremity of the abdomen is notched. *Z. granulosa*, however, has five pleon segments, and *Z. tubicola* apparently has but three.[8] *Z. phryganea* differs in the much shorter antennae and four-segmented pleon.

The South Australian specimens were found in short, hollow pieces of the stem of a marine plant, broken at one end just below a node, thus forming a tube with one end closed; the habit of this Isopod, and of a small Amphipod which was taken at the same time, recalls to mind some of our Caddis worms, which utilise, quite similarly, portions of plant stems. It is possibly owing to this method of concealment that the genus has not previously been noted in Australia.

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[8] Chilton, Trans. N. Z'd. Inst., xxii., 1890, p. 203.

THE RELATIONS BETWEEN DISTRIBUTION, STRUCTURE, AND TRANSPIRATION OF ARID SOUTH AUSTRALIAN PLANTS.

By J. G. Wood, B.Sc., Department of Botany, University of Adelaide.

[Read September 11, 1924.]

In an earlier paper (11), the author showed the effect of structural modifications on the transpiration rates of the chlorophyllous organs of several arid Australian plants. This paper embodies the result of further work on transpiration, the plants selected coming from more definitely xerophytic, and from more sharply defined habitats than those previously described.

Physical Environment.

The experiments were carried out at Curnamona, a sheep station about 250 miles north-east from Adelaide and 45 miles south of Lake Frome. Curnamona is situated near the centre of a great plain which stretches from a spur of the Flinders Range traversed by the railway line to Broken Hill at the south to Lake Frome at the north. The plain is bounded by the Flinders Range on the western side.

As one proceeds northwards the environment becomes progressively more arid. The average annual rainfall at Koonamore, at the south of the plain, is 8·46 inches, at Curnamona it is 7·03 inches, and at Frome Downs, near Lake Frome, it is 5·76 inches. The aridity of the environment is still further increased by the action of wind and of insolation. A general survey of the ecology of this district has already been published (7). In this paper, climatic data and also the analyses of numerous soil samples taken in this area were given. It was pointed out that in this region there was no striking variation in physiographic features, and little abrupt discontinuity in climatic factors.

Under such conditions edaphic factors are of great importance in determining the distribution of the vegetation, and Osborn and Wood *(loc. cit.)* showed the significance of such factors in the distribution of several halophytic and non-halophytic communities.

This paper deals with the water relations of the plants as effecting distribution.

Methods.

The methods of measuring the rate of transpiration and the various climatic factors were the same as those already described in the paper previously cited.

Comparsion of the curves previously given for the evaporation, temperature, and light intensity at Dilkera with those at Curnamona given here show higher values throughout in the latter case.

Structure and Distribution of the Plants.

The plants used were *Kochia planifolia* (bluebush), *Acacia aneura* (mulga), *Eremophila glabra* (tarbush), *Acacia Victoriae* (=*A. sentis*, prickly acacia), *Loranthus quandang* (grey mistletoe), and *Senecio magnificus*.

Of these plants *Kochia planifolia*, *Acacia aneura*, and *Eremophila glabra* are the character plants over the level plain. *Kochia* is the most frequent, and its blue-grey foliage gives a very characteristic facies to the plain. *Eremophila glabra* and *Acacia anuera* are more local. The bluebush usually forms a very

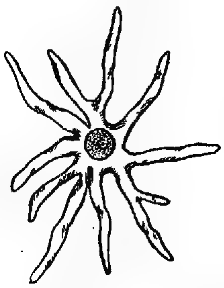
pure community, but in places *Atriplex vesicarium* is associated with it. Analyses of the soils from the plain (7) showed that the water-retaining capacity at saturation, and also the percentage of soluble salts were lower than in soils characteristic of *Atriplex vesicarium* communities. From these data the opinion was expressed that the bluebush community was of a more xerophytic type than the saltbush *(i.e., Atriplex vesicarium)* which is replaced by the bluebush as one proceeds northwards (7). Transpiration experiments confirm the contention that increased aridity of the environment is the factor determining the distribution.

Kochia planifolia, F. v. M.

This bluebush forms rounded shrubs from one-half to one metre in height. The bushes are freely branched and bear numerous subcylindrical leaves with a constricted base. The leaves are from one to two centimetres long and are covered with a thick felt of hairs. The leaf is succulent and has a similar structure to that described for *Kochia sedifolia* (11).

The epidermis of the leaf is uncutinised with simple stomates. The chlorenchyma is peripheral and the water storage tissue central. As in *K. sedifolia,* the chief interest lies in the hairs. Each hair has a branched stellate structure as figured (fig. 1). The presence of living protoplasm in the stalk cells makes it probable that the hairs have a water-absorbing function. The hairs form a thickly woven felt over the surface of the leaves.

a.



b

Fig. 1.
Stellate hairs of *Kochia planifolia.*
a, Viewed from below. *b,* Side view. ×281.

Acacia aneura, F. v. M.

In this district, the mulga is a tree with a characteristic canopy-topped habit, and is limited to groves where the soil is slightly more sandy than that of most of the terrain. The phyllodes, about 10 centimetres long and 2 centimetres wide, are narrow and not of the "broad-leaved" type. The structure of the phyllode is essentially like that of *A. linophylla* which Cannon (2) figures. A diagram of *A. aneura* is given here for comparative purposes (fig. 2). The outer margin of the section is crenulate, but not regularly marked into furrows and ridges. The stomates occur in the depressions and the guard cells have a cutin collar as shown. The whole epidermis is covered with small cellular trichomes.

Eremophila glabra, (R. Br.) Ostenf.

This plant grows as a tall shrub or small tree in isolated thickets. The leaves are crowded in condensed shoots at the ends of the branches. The structure of the leaf is shown in fig. 3. The leaf is iso-bilateral, stomates and hairs being developed on both sides. The epidermis is cutinised; the guard cells of the stomates have subsidiary cells and the cuticle of the epidermal cells projects as long papillae forming collar-like ridges.

Two types of hairs are developed on the epidermis—ordinary covering hairs which are multicellular and uniseriate, and glandular hairs. The latter are sunken in the epidermis in the old leaf, but this is a secondary development (3). The glandular hairs are of the capitate type, and are differentiated into basal, stalk, and head regions. The basal cell is large and is imbedded in two subsidiary cells, which, like the basal cell, have densely granular contents. The stalk is unicellular. The divisions in the head are all vertical and are formed in a radial manner, giving the type of subspherical shield of eight radiating cells figured by Miss Collins (3) for *E. latifolia.* In addition to the glandular hairs shizogenous secretory cavities are developed in the mesophyll.

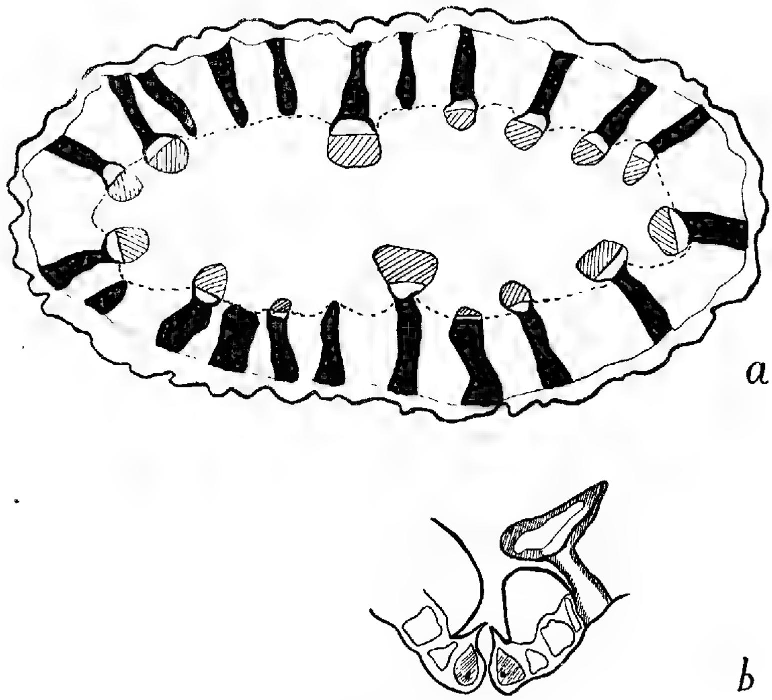


Fig. 2.

a, Diagram of transverse section of phyllode of *Acacia aneura.* Sclerenchyma, black; xylem, shaded; inner wall of epidermis indicated by unbroken line; inner limit of chlorenchyma indicated by broken line. Water storage tissue central ×17.

b, Furrow of phyllode, showing thick cuticle, stomate and collapsed hair. ×249.

The chlorenchyma is not continuous under the upper and lower epidermes of the leaf, but alternates with larger cells containing no chloroplasts but with watery contents and frequently with crystals of calcium oxalate. These cells usually occur beneath the glandular hairs, the chlorenchymatous cells beneath the stomates. The empty cells appear to be comparable to the hypodermal layer in such genera as *Atriplex,* and to have a water-storing function. The veins are simple with little mechanical tissue developed.

Acacia Victoriae, Benth.

This tree grows in a different habitat from the above three plants. It is limited to watercourses and swamps where there is a permanent water table. The phyllode structure is similar to that found in several Central Australian

species of *Acacia* of this type. The phyllode is strictly bi-facial, double bundles often occurring. Fig. 4 illustrates the general structure. The centre of the leaf is occupied by water-storage tissue, the cells being parenchymatous and containing

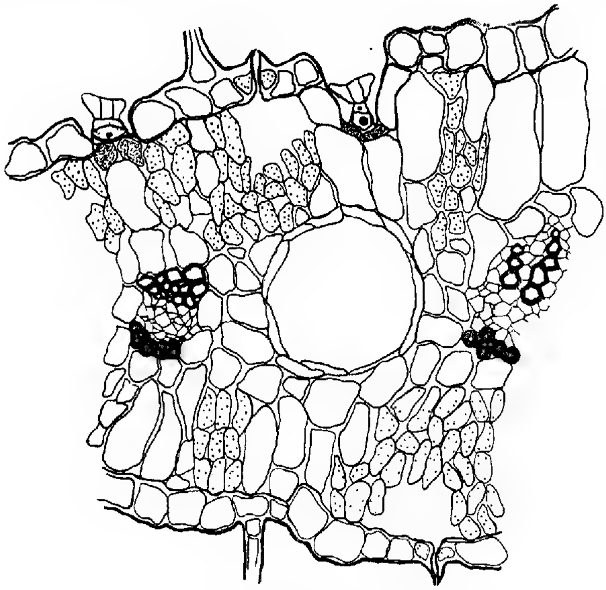


Fig. 3.
Transverse section of leaf of *Eremophila glabra*. ×93.

great quantities of tannin. This is shown black in the figure. The rest of the phyllode is occupied by chlorenchyma, the cells being palisade-like with few air spaces between them. The stomates are not depressed. No trichomes are developed on the epidermis, but the latter is fairly heavily cutinised.

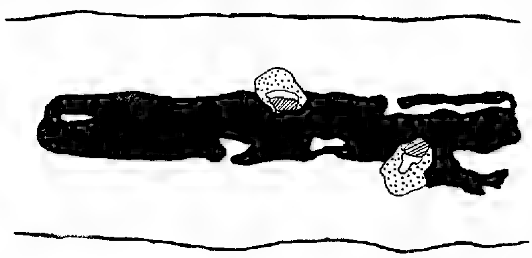


Fig. 4.
Diagram of transverse section of phyllode of *Acacia Victoriae*. Chlorenchyma colourless. water-storage tissue containing tannin central. Xylem shaded, sclerenchyma dotted. ×31.

Senecio magnificus, F. v. M.

This is an erect glabrous perennial with large glaucous leaves from four to six centimetres long and about two centimetres wide. The stem is almost herbaceous. The leaves are ovate-lanceolate and coarsely toothed. The plant is found only near a copious water supply, usually in sandy soil.

The leaf structure shows it to be of a mesophytic type. The epidermis is thinly cutinised. The stomates are small but in no way protected. The leaf is

bi-facial, the mesophyll consisting throughout of loosely packed, palisade-like chlorenchymatous cells (fig. 5).

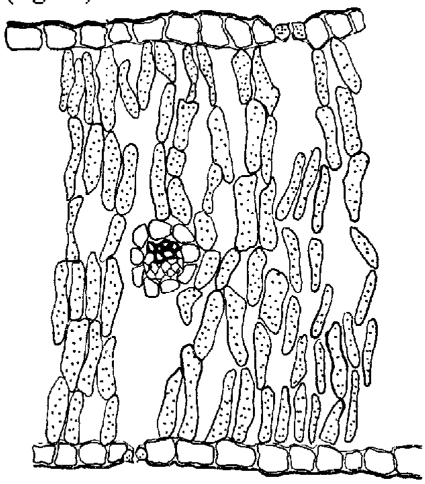


Fig. 5.
Transverse section of leaf of *Senecio magnificus.*
×47.

Loranthus quandang, Lindl.

Loranthus quandang is parasitic upon the branches of *Acacia aneura.* The leaves are usually three to four centimetres long and two centimetres wide. They are covered with a dense tomentum of stellate hairs with a single stalk cell. They are developed in great numbers over the epidermis. The stomates are large and each guard cell has a subsidiary cell. The leaf is not differentiated

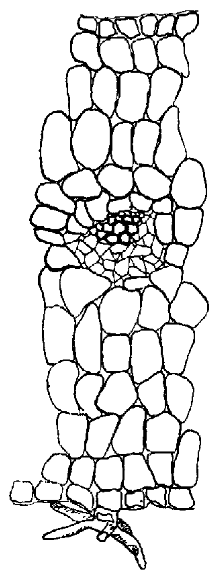


Fig. 6.
Transverse section of the leaf of *Loranthus quandang.*
×93.

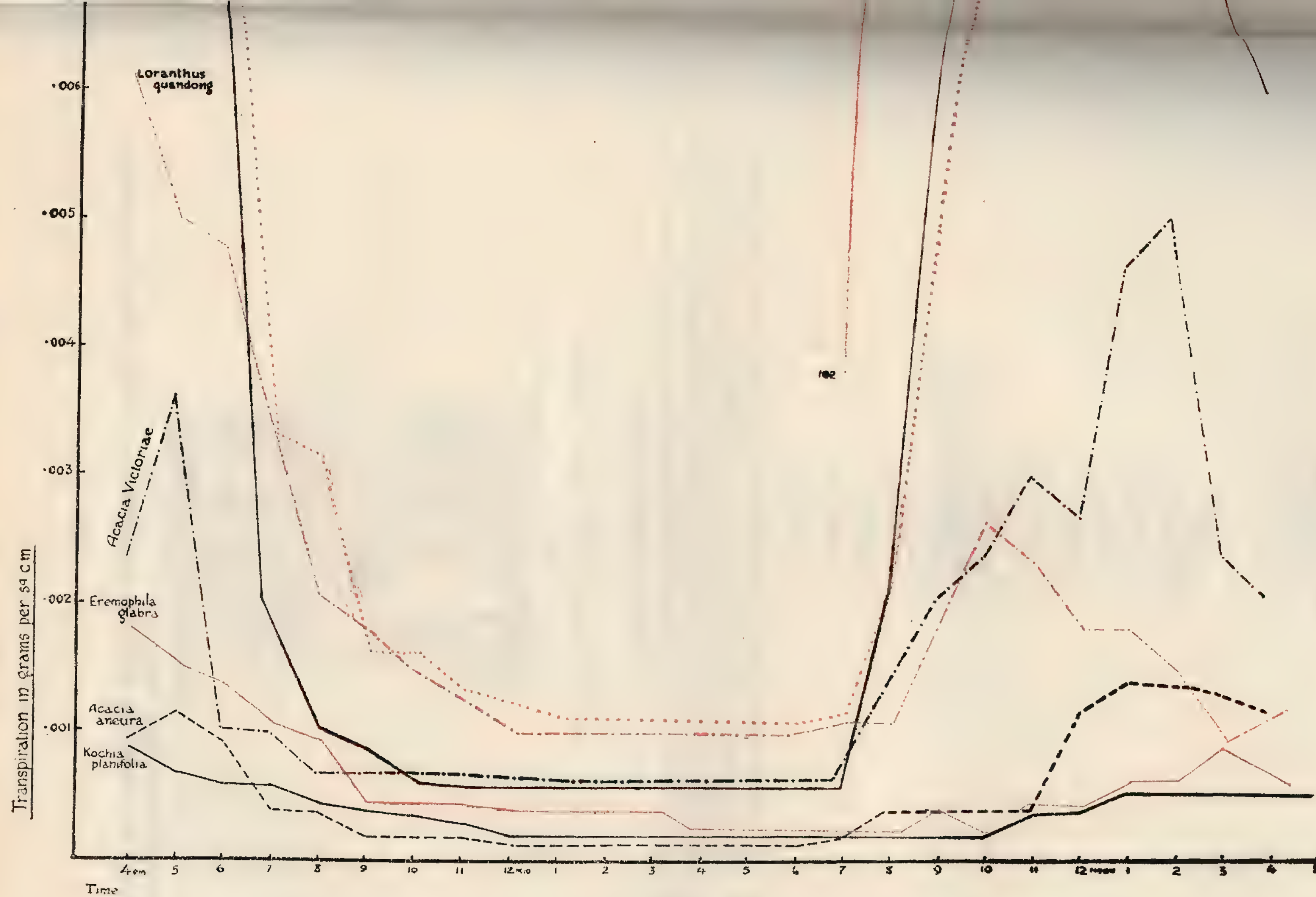
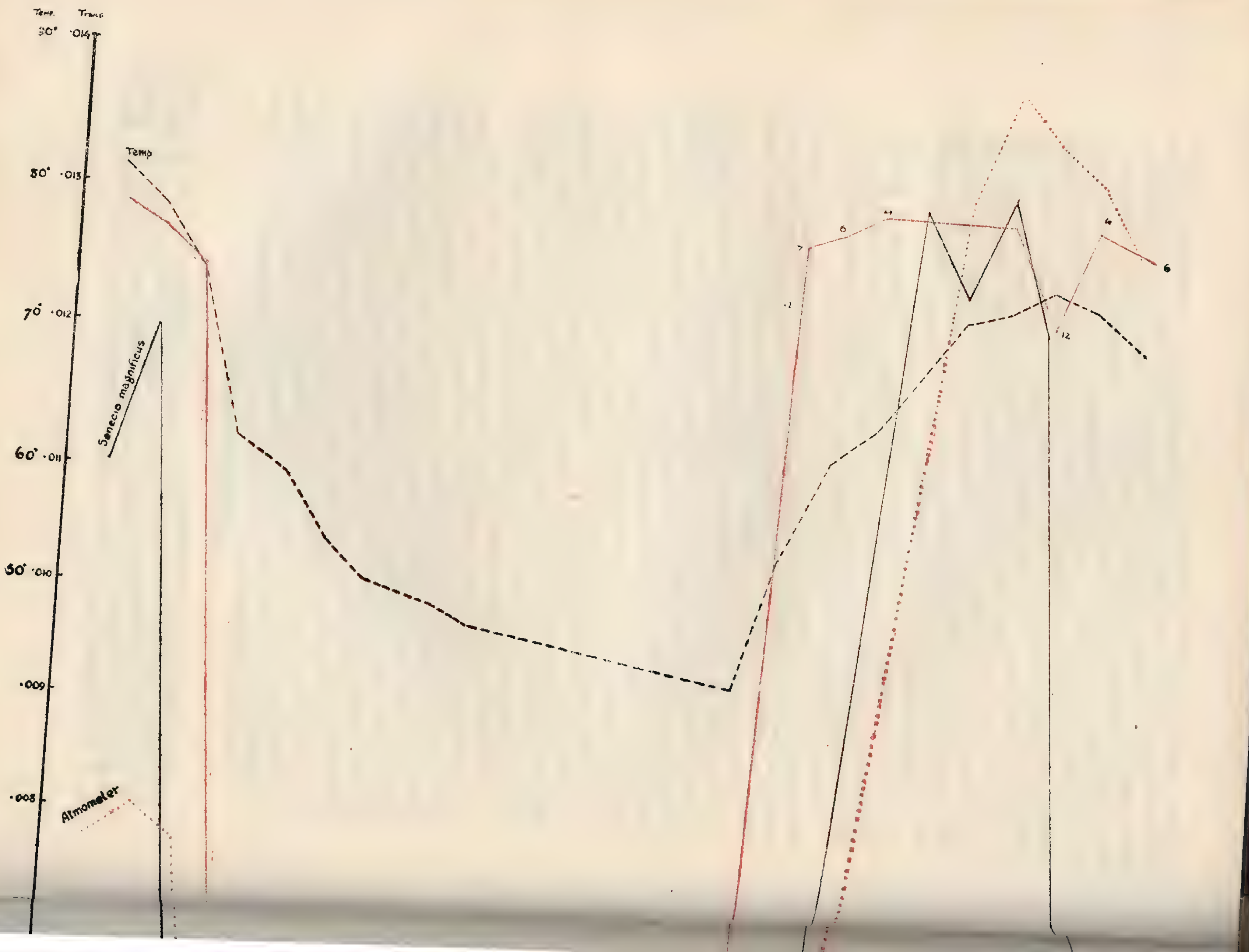


Fig. 7.

Curves for transpiration and various external factors. Amount as ordinate and time as abscissa in each case. The atmometer curve is compressed from 12 noon to 4 p.m. The actual readings are given in Table I.



Temp.
Trans
90°
·014
80°
·013
70°
·012
60°
·011
50°
·010
·009
·008
Temp
Senecio magnificus
Atmometer
6
12

to a great extent. The mesophyll cells are approximately isodiametric, closely packed together with few air spaces, and contain very little chlorophyll. There is no mechanical tissue apart from the xylem. Many of the cells have a refringent, ring-like body containing a cluster of crystals in the centre. Their chemical nature is not at present clear.

TRANSPIRATION.

Analysis of the transpiration curves shows, in the first instance, that external conditions are the most important factors influencing the rate of transpiration. The transpiration curve is of the same general type as that for the evaporating power of the air. *Kochia planifolia* has an almost flat curve similar to that of *K. sedifolia* described before (11), and illustrates the efficient insulating effect of the thick covering of hairs. The actual readings for the transpiration rate and for the physical factors are given in the following table. It will be seen that temperature, evaporating power, and light intensity are much greater than they were at Dilkera, and consequently the transpiration rate during the day is slightly higher, but is not proportionately greater. The curve for the evaporating power of the air is one-tenth the scale of the transpiration curves. All transpiration and evaporation figures are in milligrams per square centimetre per hour.

The plants from the different habitats show markedly different transpiration rates. Those from the plains *(Kochia planifolia, Acacia aneura,* and *Eremophila glabra)* have analogous curves for the transpiration rate plotted against time, and also the numerical values for the rates of water-loss per square centimetre per hour vary less than a milligram from one another. *Kochia planifolia,* however, is more definitely arid. One concludes that these plants of the plains are in a stable state of balance with their environment. It is an interesting case of the response of plant organisms to the complex of stimuli of an arid environment along separate structural lines. In spite of the anatomical differences the plants converge in having their rates of transpiration reduced to an approximately constant common level. It should be noted, however, that *Kochia* is the dominant plant, and that *Acacia aneura* and *Eremophila glabra* are local.

Acacia Victoriae shows a higher transpiration rate than the above three plants, as might be expected from its habitat. The amount of water lost is still small, however, and lies within the range of that lost by several plants investigated in the Arizona deserts (4, 9).

Senecio magnificus is typically mesophytic. Such lavish transpiration would not be possible in any other habitat but one with a constant water supply. The approximation in form of the transpiration rate curve for this plant to that for the evaporating power of the air will be evident from fig. 7.

Loranthus quandang is of special interest, as it is parasitic upon the mulga. The plant is lavish in its transpiration of water when compared with the other plants with which it is associated. Its transpiration is greatly in excess of that of its host. In this case the correlation between transpiration and absorption of soil water is not so essential. The mistletoe has all the water stores of the mulga to draw upon. It is well known that plants which obtain water and dissolved substances from the bodies of other living organisms have higher osmotic pressures than have their hosts, and it is interesting to find that the transpiration rate (at least in *Loranthus quandang)* is also much higher. The increased supply of water and mineral nutrients to the mistletoe as compared to shoots of its host will be obvious. It is very rare to find a specimen of *Acacia aneura* that has not several plants of the mistletoe upon it, and its success in this region is probably due in no small measure to the above two physiological factors together with its condition of parasitism.

TABLE I.

Plant, etc.	3·0 p.m.	4·0	5·0	6·0	7·0	8·0	9·0	10·0	11·0	7·0 a.m.	8·0	9·0	10·0	11·0	12·0	1·0 p.m.	2·0	3·0	4·0	Leaf Area sq.cms.
Eremophila glabra	—	1·77	1·55	1·33	1·11	·88	·44	·44	·44	2·88	·22	·44	·22	·44	44	·66	·66	·88	·66	225·0
Kochia planifolia	—	·86	·69	·60	·57	·43	·35	·35	·29	1·14	·14	·14	·14	·35	·35	·50	·50	·50	·50	700·0
Loranthus quandang	—	6·17	5·00	4·74	3·23	2·06	1·76	1·46	·58	7·64	1·16	1·76	2·64	2·32	2·06	—	1·46	·88	1·16	171·4
Senecio magnificus	—	11·03	12·24	7·24	2·07	1·03	·86	·69	·69	4.83	2·07	6·20	10·17	13·62	12·93	13·80	12·58	7·41	6·03	288·8
Acacia aneura	—	·96	1·15	·96	·38	·38	·19	·19	·19	1·77	·19	·38	·38	·38	1·15	1·34	1·34	1·15	1·15	259·4
Acacia sentis	—	2·33	3·66	1·00	1·00	·66	·66	·66	·66	4·00	1·33	2·00	2·33	3·00	2·66	4·66	5·32	2·33	2·00	152·8
Atmometer	—	77·0	80·5	77·5	33·0	31·0	16·0	16·0	13.0	73·0	22·0	41·5	71·5	114·0	162·0	213·0	202·0	190·5	188·0	—
Light	4	7	12	Set	—	—	—	—	—	102	12	7	6	4	4	4	12	4	6	—
Temperature, °F.	83·0	81·5	78·0	63·0	60·0	54·5	51·5	50·0	48·0	44·0	55·5	64·0	67·0	72·0	77·0	78·0	80·0	79·0	75·0	—

Discussion and Conclusions.

In any plant, its photosynthetic and respiratory activities necessitate a movement of water, and this occurs from the root or other absorbing organ through the various tissues to the stomates of the transpiring organ. The relation of a plant organism to the water supply and to the evaporating power of the air is the most important factor controlling the distribution and habitat of the plant organism.

In arid regions, a plentiful supply of water is limited to a few months, or it may be a few weeks of the year, and reduction of the amount of water lost by transpiration will be a necessary feature of any plant which is to survive under such conditions. Both water absorption and transpiration are greatly influenced by three factors—external or climatic, morphological, and physiological conditions. In a previous communication (11) the connection between transpiration and leaf structure was traced. There was shown the relative efficiency in the reduction of water-loss by such morphological modifications as heavily cutinised epidermes, collars around stomates, development of oil glands and of trichomes. Also the efficiency of these structures in protecting the stomates from external influences was considered. This paper broadens the scope of the investigations and considers the habitat.

In the mesophytic plants like *Senecio* abundant transpiration occurs; in *Acacia Victoriae* there is a lessening of transpiration due to a heavier cutinisation of the epidermis, and in *Acacia aneura* and *Eremophila glabra* the structural modifications become intensified. These plants form a graded series, not only as regards habitat, which is progressively becoming drier, but as regards modifications of structure and amount of water lost by transpiration. *Atriplex vesicarium,* the saltbush, and particularly *Kochia,* the bluebushes, are the character plants over the terrain. In these plants is reached the climax, as it were, in water conservation.

A consideration of the floras of the arid regions of the world shows that the growth forms can be divided into three groups:—

(a) Succulents.
(b) Indurated microphylls.
(c) Tomentose microphylls.

The indurated microphylls include all spinescent and phyllodic forms. Plants belonging to this group examined in Central Australia include *Acacia aneura, Acacia Victoriae,* and *Eremophila glabra,* and also *Geijera parviflora, Pholidia scoparia,* and *Casuarina lepidophloia,* in a previous paper (11). All these plants are woody and have reduced leaves, thickened cuticles, sunken stomates, or similar xerophytic characteristics. Such modifications, however, are not only characteristic of arid regions, but of any region where the evaporation is markedly in excess of the rainfall, as, for example, in the sclerophyll forests of the Mount Lofty Ranges near Adelaide (1), where the rainfall varies from 20 to over 40 inches, and yet similar modifications are to be seen. The degree of protection is more pronounced in the drier regions, as Curnamona, but it does not differ in kind. The reduction of leaf surface and heavier cutinisation is, in fact, similar to that shown by plants from moist climates *(i.e.,* mesophytes) which are grown under arid conditions (4, 8). These developments are purely the response of the plant organism to the complex of stimuli which makes the environment arid, that is, increased insolation, increased temperature, decreased relative humidity, and decreased water supply. Such modifications as are possessed by these indurated plants must, it seems, be considered as inherited variations, and as the more primitive response to arid conditions. The woody stems of these plants doubtless act as reservoirs of water in many forms.

Succulent plants as the Cactaceae, Crassulaceae, Euphorbiaceae, and so on, give a distinct facies to many arid regions. They dominate the deserts of Arizona and Texas, portions of the deserts of South America, and in the Karroo and parts of Namaqualand in South Africa. In these plants the amount of transpiration is markedly less than the absorption during the wet season, and large amounts of water are stored in the parenchymatous and tracheidal tissues of the stem or leaf. So efficient are these storage organs that many Cactaceae will withstand a prolonged period of desiccation of three years under experimental conditions (6). Such forms, as MacDougall (6) has pointed out, show evidently a secondary and more highly specialized condition of xerophytism.

One other growth form remains for consideration, the tomentose microphylls. These are all perennial shrubby plants and include in Australia saltbushes *(Atriplex* spp.), bluebushes *(Kochia* spp.), and certain species of *Rhagodia.* Sagebushes *(Artemisia* spp.) are the dominant plants in the Great Basin Desert of North America; and the Karroo bush *(Pentzia)* is dominant in the Upper Karroo of South Africa. These plants have all a dense tomentum of hairs over the epidermis. They are characteristic of the drier portions of the various arid regions mentioned, and their success appears to be due to the efficiency of the hairs in reducing transpiration and also to the development of efficient absorbing organs, either by an extensive root system or by other means. It has been shown that the Central Australian species have a very low rate of transpiration. Further unpublished observations by the writer show that some plants from arid Australia are capable of absorbing water from the air through their leaves. MacDougall has shown that the sagebush, *Artemisia tridentata,* has a transpiration rate practically identical with that of *Atriplex vesicarium, viz.,* of 0·4 milligrams per square centimetre per hour (5), and at the same time an extensive root system is developed (10). These tomentose forms, too, we must consider as secondary and not as primary forms in response to arid conditions.

Transpiration studies, it will be seen, when taken in conjunction with the soil-water relations of the plant, give a very valuable insight into the determination of the distribution and of the habitats of desert plants. As regards Australian habitats, it shows clearly the reasons for the dominance of individual species in particular localities.

In conclusion, I wish to thank Professor T. G. B. Osborn for help throughout this work; and also the Managing Director (A. G. Rymill, Esq.) of the Canowie Pastoral Company, owners of Curnamona, and also their manager (Mr. L. Boothby, of Curnamona).

Literature Cited.

1. Adamson, R. S., and Osborn, T. G. B.
   On the Ecology of the *Eucalyptus* Forests of the Mount Lofty Ranges, Trans. Roy. Soc. S. Austr., xlviii. (1924), p. 87.
2. Cannon, W. A.
   Plant Habits and Habitats in the Arid Portions of South Australia, Carn. Inst. Publ., No. 308 (1921).
3. Collins, M. I.
   On the Structure of the Resin-secreting Glands in some Australian Plants, Proc. Linn. Soc. N.S. Wales, xlv. (1920), p. 329.
4. Livingston, B. E.
   The Relation of Desert Plants to Soil Moisture and to Evaporation, Carn. Inst. Publ., No. 50 (1906).

5. MacDougall, D. T.

Botanical Features of the North American Deserts, Carn. Inst. Publ., No. 99 (1908).

6. MacDougall, D. T., and Spalding, E. S.

The Water-balance of Succulent Plants, Carn. Inst. Publ., No. 141 (1910).

7. Osborn, T. G. B., and Wood, J. G.

On some Halophytic and Non-Halophytic Plant Communities in Arid South Australia, Trans. Roy. Soc. S. Austr., xlvii. (1923), p. 388.

8. Palladin, V. I.

Plant Physiology, 2nd American Edition, Philadelphia (1922).

9. Shreve, E. B.

The Daily March of Transpiration in a Desert Perennial, Carn. Inst. Publ., No. 194 (1914).

10. Weaver, J. E.

The Ecological Relations of Roots, Carn. Inst. Publ., No. 286 (1919).

11. Wood, J. G.

On Transpiration in the Field of some Plants from the Arid Portions of South Australia, with Notes on their Physiological Anatomy, Trans. Roy. Soc. S. Austr., xlvii. (1923), p. 259.

AUSTRALIAN FUNGI: NOTES AND DESCRIPTIONS.

No. 5.

By J. Burton Cleland, M.D.

[Read October 9, 1924.]

This paper is a further contribution to the records of the larger Australian fungi and includes descriptions of additional new species. As the authors (Cleland and Cheel) of this series are now located in different States, they propose contributing the papers independently of each other, unless special collaboration has occurred. Our previous papers have appeared in these Proceedings as follows:—No. 1, xlii., 1918, p. 88; No. 2, xliii., 1919, p. 11.; No. 3, xliii., 1919, p. 262; and No. 4, xlvii., 1923, p. 58. Where a species has been previously dealt with by us, the reference is given in brackets (*e.g.*, iii., 90). Where colour tints are specifically noted in capital letters, they are based on Ridgway's "Colour Standards and Colour Nomenclature," unless Dauthenay's "Repertoire de Couleurs" is specially indicated. We would again like to state how much we owe to Mr. C. G. Lloyd for identifying specimens for us, and to thank those in Australia who have aided us by sending us fungi that they have collected.

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WHITE-SPORED AGARICACEAE.

AMANITA.

382 (iii., 90). *Amanita grossa*, Berk. N.S. Wales: Kendall, March; North Bridge, Sydney, April. South Australia: Mount Lofty, March, July, spores subspherical, 9·3 to 11×7·5 μ, 8 to 9 μ.

383. *Amanita ochrophylla* (Cke. and Mass.). We have previously referred these Australian plants to *Amanita strobiliformis*, Vittad (Agric. Gaz., N.S. Wales, xxv., Dec., 1914, p. 1045), sinking *Lepiota ochrophylla*, Cke. and Mass., as a synonym. Now we have come to the conclusion that the specific name *ochrophylla* should stand, and that the species is best placed under *Amanita*. N.S. Wales: Neutral Bay, Jan.; Narrabeen, March. Victoria: Near Ararat in sandy soil, up to 10 cm. in diameter, E. J. Semmens, No. 1. South Australia: Two small specimens, collected by Prof. Howchin in sandy scrub near the coast, Hundred of Waitpinga, Encounter Bay, in 1909, appear to be this species, spores 10·5 to 11·5×6 μ. Typical specimens were found at Mount Lofty in April, 1924, after early autumnal rains and mild weather; smell strong, pileus scaly and near Pinkish Buff (xxix.), the stems usually the same colour but sometimes tinted with Light Vinaceous Cinnamon (xxix.), gills becoming Buff Yellow (iv.), cut surface sometimes tinted with Vinaceous Russet (xxviii.), spores white and subspherical, 7·5 μ, 9×7·5 μ.

384. *Amanita muscaria*, (L.) Fr. Cke., Hand. Austr. Fungi, No. 7 (Vict.). South Australia: Under oak and spruce, Aldgate, March, 1924 (Dr. M. Scott and Mrs. Barclay), typical and very handsome specimens, some partly eaten by slugs or other animals.

385. *Amanita rubescens*, (Pers.) Fr. South Australia: Under chestnuts, Mount Lofty (near the summit), March and April, 1924, spores subspherical to elliptical, 9·3×6·5 μ, 7·5 μ. These specimens are typical, the only difference noted from Carleton Rea's description in British Basidiomycetae is in the patches on the pileus being membraneous-warty rather than mealy.

AMANITOPSIS.

386. *Amanitopsis vaginata*, (Bull.) Roze. Cke., Hand. Austr. Fungi, No. 11 (Q'land, N.S. Wales, Vict.). N.S. Wales: Neutral Bay, Feb., March; Kendall, Dec. In Sydney specimens, undated, the spores were thick-walled, spherical,

10·4 to 13·8 μ; the following colours were noted: periphery of the pileus Chocolate (Dauthenay, pl. 343, ton 1), darker towards the centre (tons 2 and 3), and in another plant near Pale Otter Brown (pl. 354, ton 1), paler than Loutre.

LEPIOTA.

387. *Lepiota procera,* (Scop.) Fr. Cke., Hand. Austr. Fungi, No. 16 (Q'land, N.S. Wales, Vict., Tasm.). Victoria: Ararat (E. J. Semmens), spores 17 to 19×10·4 μ. South Australia: Spores 16 to 22·5×9·5 μ; amongst grass usually under trees, National Park, South Australia, April, May, eaten by the author; near Mount Lofty, March, June; Kinchina, July.

388. *Lepiota Morgani,* Pk. We refer the following, chiefly on account of the definite but slight greenish tint of the spores, to this American species, but with considerable doubt. Our specimens are smaller than the usual dimensions given for *L. Morgani,* the plant is about as broad as long, the gills though free are not remote from the stem, the latter is hollow, and the ample ring appears to be fixed. Pileus 3 inches or more across, convex, broadly gibbous, cuticle cracked, with a dark-brown crust at the apex, the rest whitish with pale-brown, rather imbricate, fibrous scales. Gills just free, close, white, then with a pale-green tint. Stem 3 inches or more long, moderately slender, striate, pale brownish, hollow. Ring ample, moderately superior, apparently fixed. Smell strong. Spores microscopically pale dingy-greenish, oblique, not thick-walled, 8·5 to 10·4 by 6 to 7 μ. On the ground, Moore Park, Sydney, Dec. 2, 1917.

389. *Lepiota naucina,* Fr. Cke., Hand. Austr. Fungi, No. 31 (Vict.). Clel. and Cheel, Agric. Gaz. of N.S. Wales, xxvi., April, 1915, p. 33 (N.S. Wales). South Australia: In grass, Beaumont, Feb., June (eaten by slugs), centre of the pileus in some specimens Buffy Brown or Wood Brown (xl.).

390. *Lepiota licmophora,* B. and Br. Clel. and Cheel, Agric. Gaz. of N.S. Wales, xxvi., April, 1915, p. 332. N.S. Wales: Mosman, Jan., March.

391. *Lepiota cepaestipes,* (Sow.) Fr. Cke., Hand. Austr. Fungi (Q'land). Clel. and Cheel, Agric. Gaz. N.S. Wales, xxvi., April, 1915, p. 331. We have already recorded from Australia, as this species, a small-spored plant (like that described by Petch, Anns. Roy. Bot. Gdns., Peradeniya), and referred to a large-spored plant (like that met with in America—Peck, N. York State Mus., Bull. 94, 1904, p. 44), as being "obviously a different species," though the description of *L. cepaestipes* would apply to it. We have collected this large-spored form in the Botanic Gardens, Sydney, in April. Pileus Primrose Yellow, Lemon Yellow (Dauthenay, pl. 19, ton 1), stem the same colour from ton 1 above to ton 2 below, spores 8 to 12×6·8 to 7·2 μ, Neutral Bay, March.

392. *Lepiota cristata,* Fr. Clel. and Cheel, Agric. Gaz. N.S. Wales, xxvii., Feb., 1916, p. 99. South Australian specimens do not seem to attain a diameter of more than an inch. Pileus Chestnut Brown (xiv.); base of stem Light Russet Vinaceous (xxxix.). Spores usually 4·8 to 6·4×3 to 3·5 μ. Amongst grass, Adelaide and suburbs, June (Miss Fiveash, Watercolour No. 10); under pines, Frome Road, Adelaide, May, spores 8 to 8·5×5 μ.

ARMILLARIA.

393 (iii., 92). *Armillaria mellea,* (Vahl.), Fr. N.S. Wales: Bradley Head, April; Taronga Park, May; Mosman, May, pileus almost black, definite remains of a pale-brownish ring $\frac{7}{8}$ inch below the pileus, and just below the pileus a flimsy veil rupturing to form a very definite second ring; National Park, May, pileus Raw Sienna to Sudan Brown (iii.), ring further away than usual from the gills (1 inch), spores 7·5 to 8·5×5 μ; Neutral Bay, July. South Australia: Kuitpo, at base of stump, May; near the base of *Acacia pycnantha,* Benth., National Park,

Aug., also in April; Mount Lofty, June, pileus Buckthorn Brown to Dresden Brown (xv.), punctate with darker squames.

Mycena.

394. *Mycena galericulata*, (Scop.) Fr. A common species on posts, stumps, and at the bases of trees, rather variable, densely caespitose, apparently more slender and with less tendency to expand than is the case with the British plant. The gills often have a greyish tint and the decurrent tooth is not marked. Possibly the Australian plant is specifically distinct. Pileus Blackish Brown to Dusky Drab (xlv.) to Wood Brown (xl.); the lower part of the stem Army Brown to Natal Brown (xl.). South Australia: National Park, on posts, etc., July; Mount Lofty, June, July; Belair, June.

395 (iii., 132). *Mycena viscido-cruenta*, nom. nov. In a previous number of this series (iii., 132) we have described a new species of *Mycena* as *M. coccinea* (*coccineus* in error). As this name is preoccupied (*M. coccinea*, (Sow.) Quel.), it is necessary to change it, and so the specific name *viscido-cruenta* has been chosen, as indicating its viscid nature when moist and the blood-red colour. N.S. Wales: Mosman, April; Lisarow, Dec. South Australia: Waterfall Gully, June; National Park, May.

396. *Mycena tenerrima*, Berk. South Australia: At first a minute knob with frosted granules. Pileus $\frac{1}{8}$ inch + (3 mm. +), broadly campanulate or conico-convex, the centre slightly flat on top or depressed, striate, frosted with granules, pure white or with a greyish tinge. Gills adnexed or just free, no collar, slightly ventricose. Stem $\frac{1}{4}$ inch (10 mm.) high, very slender, with white granules or minute hairs, attached to wood by a minute mealy bulb. Microscopically the cell-like hyphae of the pileus are covered with granules. Spores not seen. On the base of a Eucalyptus trunk, Green Hill Road, June, 1923.

Omphalia.

397. *Omphalia chromacea*, n. sp.—Whole plant near Deep Chrome (iii.) or a little yellower when moist, or Yellow Ochre (xv.), drying to an opaque Pale Orange Yellow (iii.) to Light Orange Yellow (iii.), the gills and stem remaining nearer Deep Chrome. Pileus up to $\frac{3}{4}$ inch in diameter, rarely reaching 1 inch, convex, then sometimes plane, slightly umbilicate, irregularly rugose. Gills decurrent, edges rather thick, a few short ones interposed, distant, sometimes forked or anastomosing or with buttressing folds. Stem up to $\frac{3}{4}$ inch long, slender, equal or slightly attenuated upwards, tough, surface dull, solid, flesh yellow. Spores narrow pear-shaped, oblique, 6 to 9·5 by 3 to 5 μ. Cystidia not seen. Gregarious on bare sandy loam or amongst low moss. South Australia: Mount Lofty, April, June, July (whole plant Yellow Ochre, pileus a little more orange, spores 8 to 8·5×5 μ), Aug., Sept.; Waterfall Gully, June (spores 8 to 9·5 by 3·8 μ); National Park, June; Adelaide, July. N.S. Wales: Ryde, May (edge of the pileus turned in when young); Tuggerah, Oct., on damp bank (spores 5 to 7 by 3·4 μ); Leura, June; Bumberry, Sept.; near Dubbo, Aug.; The Rock, July; a white form was found at Neutral Bay, Sydney, in May (spores 7 by 3·5 μ).

Planta chromacea, hygrophana. Pileus ad 16, rariter 25 mm. latus, convexus, interdum planus subumbilicatus, irregularitur rugosus. Lamellae decurrentes, marginibus subcrassis, distantes, interdum furcatae vel anastomosae vel plicis suffultis. Stipes ad 16 mm. latus, tenuis, equalis vel sursum attenuatus, solidus. Sporae pyriformes, obliquae, 6-9·5×3·5 μ.

The following resemble *Omphalia chromacea*, but the spores are narrower:—Pileus pallid brownish-yellow to brownish-orange. Gills whitish. Stem pale

brownish-yellow, hollow above where it expands into the gills. Spores 4·5 to 7×2 to 2·5 μ. N.S. Wales: On the ground, amongst moss, Neutral Bay, Sydney, May (D. I. Cleland, Watercolour No. 16). Also Neutral Bay, May and June, spores elongated, narrow, 5·2×2 μ, occasionally 7×2 μ; Lisarow, June, spores 5×2 μ; N.S. Wales: spores 5·2×2·2 μ.

COLLYBIA.

398 (iii., 119). *Collybia radicata,* (Relh.) Berk. Spores 16 to 21×11 μ. N.S. Wales: Chatswood, Sydney, March, May (Miss Clarke, Watercolour No. 149); Tuggerah, Oct.; Lisarow, June; Bulli Pass, April; Bumberry, Sept. Vict.: Ararat, E. J. Semmens, No. 3. South Australia: National Park, Aug.; Mount Lofty, June, gills subdecurrent, not adnexed; Beaumont, near Adelaide, June, July.

399 (iii., 120). *Collybia velutipes,* (Curt.) Fr. Spores 7 to 8·5 by 3 to 5 μ (Australian), 7 to 9·5 by 4·5 to 4·8 (New Zealand). N.S. Wales: Dorrigo, Jan. Vict.: Aug., Mr. Brittlebark, Nos. 11, 12. New Zealand: Dunedin, Queenstown, and Invercargill, June; Wairaroa, on dead logs in forest, Jan., G. H. Cunningham, No. 675.

MARASMIUS.

400. *Marasmius foetidus,* (Sow.) Fr. Cke., Hand. Austr. Fungi, No. 427 (Q'land). Pileus up to $\frac{7}{8}$ inch in diameter, irregular, convex, then nearly plane, plicate, near Burnt Umber (xxvii.) when moist, drying to near Walnut Brown (xxvii.). Gills thick, adnate to slightly decurrent, pruinose, near Light Cinnamon Drab (xlvi.). Stem $\frac{1}{2}$ inch high, sometimes attenuated downwards, sometimes flattened, velvety, blackish. A few spores (?) seen, 9×5·5 μ. Smell distinctly foetid. South Australia: On the bark, several feet up the trunk, of living *Eucalyptus obliqua,* L'H., Mount Lofty Summit, April, 1924.

401 (iii., 130). *Marasmius equi-crinis,* F. v. M. South Australia: The pileus is a pallid biscuit-colour (near Tawny Olive, xxix.), the centre markedly dimpled with a characteristic minute dark knob in the centre of the dimple giving an appearance of great depth to the dimple; gills 8 to 11, attached to a collar; the stem brown, pallid below the pileus, up to several inches long; spores elongated, elliptical, 7·5 to 9×4·5 μ to 5·5 μ; the mycelium tough like horsehair, brown, tangled amongst fallen leaves, etc., hidden in grass; Mount Lofty, March and April; National Park, April; Green Hill Road, July (Form. Sp., No. 322). The South Australian plants seem exactly like those previously recorded for New South Wales.

HYGROPHORUS.

402 (iii., 124). *Hygrophorus miniatus,* Fr. We have already discussed the reason for referring the Australian plants to this species. Our plants resemble somewhat the description given in Cooke (No. 385) of *H. scarlatinus,* Kalchb., but the spores of this species are said to be subglobose, 3 to 4 μ. Vict.: Ararat, June and July, E. J. Semmens (Nos. 107, 128). South Australia: Pileus Scarlet to Scarlet Red to Carmine (i.), upper part of the stem of the same colour, becoming yellowish below, gills adnate with a tendency to decurrence, whitish becoming yellowish, spores elliptical 6·5 to 8×3·2 μ, Green Hill Road, amongst moss, June, July.

403 (iii., 125). *Hygrophorus conicus,* Fr. N.S. Wales: Mosman, April; National Park, May. South Australia: Botanic Gardens, in grass, June, pileus Ox-blood Red (i.), up to $2\frac{1}{4}$ ins. in diameter, the stem the colour of the pileus but slightly greenish below.

404. *Hygrophorus candidus,* Cke. and Mass. Cke., Hand. Austr. Fungi, No. 379 (Vict.). South Australia: Pileus and stem glutinous, fragile. Pileus

up to 2 inches in diameter, conico-convex to convex, then expanding and nearly plane, gibbous to umbonate, edge turned in and thin and sometimes striate, pure white with brownish-biscuity tints round the centre. Gills adnate or adnexed, close, slightly ventricose, narrow triangular on section, creamy-white. Stem up to 2½ inches high, rather flexuous, moderately slender (up to ¼ inch thick above), attenuated downwards, slightly hollow, white. Spores elliptical to subspherical, sometimes a little irregular but not rough, 6·5×4 μ, 5·2×4·8, 4·5×3 μ. Under Eucalypts, Kinchina, July; Mount Lofty, July; amongst grass under trees, Beaumont Common, May (the thick gluten forming a pseudo-veil in the young plant); National Park, April.

Cantharellus.

405 (iii., 101). *Cantharellus lilacinus,* Clel. and Cheel. South Australia: Mount Lofty, July.

PINK-SPORED AGARICACEAE.

Volvaria.

406. *Volvaria speciosa,* Fr. Spores pale brownish, 14 to 15·5 by 8·5 μ. N.S. Wales: Mosman, May, pileus whitish with a slight brownish tint, gills with a flesh tint.

407. *Volvaria bombycina,* (Schaeff.) Fr. We attribute the following to this species:—Pileus 4 inches in diameter, broadly conical with a large obtuse umbo, smoky-brown, cuticle cracking in a radiate fashion leaving a pallid white between the irregular patches and fibrillae of the cuticle. Gills close, quite free, whitish with a pink tinge, becoming salmon coloured. Stem 4½ inches high, stout, attenuated upwards, ⅜ inch thick above, the base much swollen (1·⅞ inch), solid, surrounded by a marked volva with a wide, free, slightly lobed edge. Mushroom smell. Spores oval, 8·2 by 5 μ, no cystidia seen. On soil on an old newspaper. Botanic Gardens, Sydney, Jan., 1917 (Miss Clarke, Watercolour No. 143).

408. *Volvaria parvula,* (Weinm.) Fr. N.S. Wales: Pileus ⅜ inch in diameter, convex, gibbous (?), slightly viscid (?), white. Gills apparently adnate (? free), whitish, then pale brownish. Stem ¾ inch high, slender, whitish. Volva marked, upper edge widely free. Spores pale tinted, 7 by 4·2 μ. On the ground, National Park, N.S. Wales, May, 1919.

409. *Volvaria gloiocephala,* (DC.) Fr. (Rec. for South Australia in error as *Volvaria speciosa (?)* in Jour. Proc. Roy. Soc. N.S. Wales, xlviii., 1914, p. 434). South Australia: Pileus at first rather globose, then conico-convex and umbonate, finally nearly plane with a broad obtuse umbo, up to 3¼ inches in diameter, viscid, when dry shining and finely matt at the apex, becoming finely fibrillose outwards, occasionally with white patches of the volva remaining, Light Greyish Olive (xlvi.) to Greyish Olive to Pale Smoky Grey, sometimes Clove Brown (xl.). Gills close, just reaching the stem, 7 mm. deep, whitish, then light brownish-vinaceous. Stem up to 6 inches high, very slightly fibrously striate, 1 cm. in diameter in the middle, rather expanded above, base bulbous, solid, whitish, becoming faintly tinged greyish or brownish. Flesh of the pileus watery whitish-grey, of the stem white with whitish-grey at the periphery. Volva ample, free, white, spores elliptical, 13 to 18×8 to 10·5 μ. Amongst dead herbage (thistles, "Salvation Jane"), etc. Suburbs of Adelaide, June, July; Waterfall Gully, June.

Claudopus.

410. *Claudopus variabilis,* (Pers.) W. G. Sm., var. *sphaerosporus,* Pat. Pileus up to ½ inch in diameter, convex to nearly plane, sometimes irregular, more or less flabelliform, matt or somewhat villous to floccose, edge slightly incurved, whitish, sometimes with tinges of yellow-brown; gills moderately close,

many short, adnate or slightly decurrent, radiating from a slightly fluffy lateral attachment, whitish with a faint salmon tint or pale cream, becoming pale brownish (near Sayal Brown, xxix.); sometimes with a nearly lateral, very short and hardly existent, whitish stem. Spores microscopically pale tinted to pallid brownish, elliptical, oblique, 6·8 to 8×4·2 to 5·2 μ. On logs, fallen sticks, inside a burnt hollow stump, etc. N.S. Wales: North Bridge, Sydney, July; Mosman, Oct.; Dorrigo, Jan. Vict.: Craigie, June (E. J. Semmens, No. 83). South Australia: Mount Lofty, June, in one case attached round a stem (Form. Sp., No. 287).

BROWN-SPORED AGARICACEAE.

Locellinia.

411. *Locellinia australiensis,* Clel. and Cheel. South Australia: Kuitpo, May, under *Eucalyptus* sp., gills becoming Ochraceous Tawny (xv.); Mount Lofty, July.

Crepidotus.

412. *Crepidotus eucalyptorum,* n. sp. Pileus ½ to 2¼ inches laterally, ¼ to 1½ inches from before backwards, convex, sometimes a little gibbous, surface matt to fibro-villous, sometimes becoming fibrillosely scaly, edge a little turned in, watery-brown to yellowish-brown—near Old Gold (xvi.), the villous projections Buff Yellow (iv.) to browner; a little paler than Saccardo's Umber (xxix.)—drying paler and sometimes to a dark biscuit-brown. Gills moderately close to rather distant, pallid brownish, pallid dingy yellowish, pale yellowish-brown or earthy-brown—paler than Saccardo's Umber (xxix.), a little browner than Avellaneous (xl.). Flabelliform, laterally attached by a constricted base, no definite stem. Flesh thick at centre, pellucid soapy looking. Spore mass near Raw Umber (iii.), spores microscopically dull pale brown, oblique, 7·2 to 10 by 5·2 to 6 μ. On trunks of living Eucalypts. South Australia: On living trunks of *E. viminalis,* Lab., *E. odorata,* F. v. M., etc., up to a height of 15 feet, National Park, June, 1917 (Watercolour, Miss A. Rennie, No. 5); on trunks of *E. leucoxylon,* F. v. M., Mount Lofty, July; Mount Lofty, June. Vict.: Ararat, July, 1918 (E. J. Semmens, No. 121); on trunk of *E. hemiphloia,* F. v. M., Craigie, June, 1917 (E. J. Semmens, No. 57). N.S. Wales: Pileus fibro-villous, yellow-brown, attached behind by a broad base, spores yellow-brown, on trunks of *Eucalyptus* sp., The Rock, July; laterally attached by a constricted base, often with white fluffy mycelium, on trunks of *E. rostrata,* Schl. (or *E. tereticornis),* Narrabri, May; pileus now smooth, on *E. Baueriana,* var. *conica,* Maid., Pilliga Scrub, Oct.

Pileus 1·2 ad 5·6 cm. latus × ·6 ad 3·8 cm., convexus, interdum subgibbosus, fibro-villosus, interdum fibrilloso-squamosus, margine subinvolute, flavo-fulvus. Lamellae subdensae ad subdistantes, pallido-fuscae. Planta flabelliformis, lateraliter adjuncta base constricto, astipitata. Caro crassa, subpellucida. Sporae fuscae, obliquae, 7·2-10×5·2 6 μ. De Eucalypti trunco crescens.

413 (i., 54). *Crepidotus globigerus,* Berk. N.S. Wales: The Comboyne, Sept., Bulli Pass, Nov. (Miss Clarke, Watercolour N. 164).

414. *Crepidotus subhaustellaris,* n. sp. Pileus ½ up to occasionally 1 inch broad, up to ¾ inch from before backwards, convex or irregularly convex, then often wavy and upturned, surface dull and matt becoming shiny, the edge turned in when young, pale brown to tanny or reddish-brown, drying to a biscuit colour (pileus drying to Pale Alutaceous Buff, xv., near Liver Brown, xiv., towards the attachment). Gills adnate, close, many short, dingy brown to dark earthy brown (Cinnamon Brown, xv.). Stem excentric or nearly lateral, curved, short or very short, swollen below the gills, with a mealy-white bloom and brownish beneath

this and a fluffy base. Spore mass near Mummy Brown, xv., spores microscopically pale dingy brown to dull vinous-brown, elliptical, oblique, one side a little flattened and one end more pointed, 6·5 to 7·5×4·2 to 5 μ. On trunks of living Eucalypts *(E. capitellata,* Sm., etc.), on old bagging and on a dead *Xanthorrhoea* scape. South Australia: Mount Lofty, April, May, June, July, Sept.; National Park, June (Miss A. Rennie, Watercolour No. 4); Kuitpo, Oct. Vict.: Ararat, July (E. J. Semmens, No. 132).

Pileus ad 1·2, rariter 2·5 cm. latus × 1·8 cm., convexus vel irregulariter convexus, deinde saepe undosus et recurvatus, 'matt' deinde splendens, margine primum involuto altuaceo-fuscus. Lamellae adnatae, compactae, cinnamoneo-fuscae. Stipes eccentricus vel sublateralis, curvus, brevis vel perbrevis, sub-lamillis inflatus, subfarinaceus, subfuscus, base villoso. Sporae fuscae, ellipticae, obliquae, 6·5-7·5×4·2-5 μ.

BLACK-SPORED AGARICACEAE.

Panaeolus.

415. *Panaeolus retirugis,* Fr. South Australia: On dung, spores 15·2 to 17·8×9 to 10·7 μ. Pileus pallid greyish-brown; stem near Vinaceous Buff (xl.). Glen Osmond and Beaumont, June to Sept.; Mount Compass, Oct.

Coprinus.

416. *Coprinus comatus,* Fr. Clel. and Cheel, Proc. Linn. Soc. N.S. Wales, xli., 1916, p. 853. N.S. Wales: Moore Park, Sydney, April, Dec. Vict.: Melbourne, May, spores 10·4 to 12×7 μ. South Australia: On lawn, Botanic Gardens, June (spores microscopically dark brown, 9·5 to 11×6·5, occasionally 14·5×8 μ); Beaumont, June (spores nearly black, 16 to 17·5×9·5 μ).

417 (iv., 271). *Coprinus micaceus,* Fr. N.S. Wales: Mosman, May; Milson Island, Hawkesbury River, Nov., Dec.

418. *Coprinus sterquilinus,* Fr. South Australia: When young broadly conical; pileus 1 inch high, the stem 2 inches elongating to 4 inches; pileus pure white with shaggy, scurfy scales, striate, the pink of the gills showing through; gills free, close, edges pinky-brown. Stem white, attenuated upwards, the base bulbous, hollow; a rather imperfect ring just above the base; spores black, 19·6 to 21×12·5 μ; on dung, Waterfall Gully, Sept.

419. *Coprinus niveus,* (Pers.) Fr. Cke., Hand. Austr. Fungi, No. 348, *vis.* (Vict.) South Australia: Pileus and stem nearly white, conical; edge of the pileus curly; gills adnate; stem hollow; no strong smell; spores subspherical to elliptical, black, 11 to 12·8 μ, 11×8 to 9·5 μ, in one collection 13·8 to 15·5×10 to 12μ ; on dung, Burnside, Beaumont, and National Park, April, July; Encounter Bay, Aug. This pure-white, dung-inhabiting species is evidently not *C. narcoticus,* (Batsch.) Fr., lacking the smell. The spores are larger than those of *C. stercorarius,* Fr. (7 to 10×7 to 8 μ. Rea (Brit. Basidiomyc., p. 505) says the gills are adnexed in *C. niveus* (we noted them as adnate in our specimens) and the spores are 15×10 to 12 μ, which are larger than those of our plants except in one collection, that from the National Park.

420. *Coprinus ephemerus,* (Bull.) Fr. Clel. and Cheel, Proc. Linn. Soc. N.S. Wales, xli., 1916, p. 856. We refer the following to this species, though the disc is not elevated and the spores attain to a larger size than the measurements (8 to 10×5·5 to 8 μ) given by Rea. It may be *C. curtus,* Kalchb. (= *C. plicatiloides,* Buller). South Australia: At first a minute yellowish-brown button; then conico-cylindrical, striate and yellowish-brown; then becoming more conical; finally conico-expanded and eventually upturned; the apex brownish, not specially raised or depressed, the rest of the pileus greyish and finely double ribbed; gills close, narrow, just reaching the stem, blackish; stem

up to $2\frac{1}{4}$ inches high, slightly attenuated upwards, hollow, white, silky with a slight mealiness; spores elliptical, black, 8·5 to 14·5×6·4 to 8μ; on dung, Adelaide, Sept.

421. *Coprinus plicatilis,* (Curt.) Fr. Clel, and Cheel, Proc. Linn. Soc. N.S. Wales, xli., 1916, p. 858. In our plants referred to this species, the spores are larger than the measurements (10 to 12×8 to 9 μ) given by Rea, and the stem is white, not pallid. South Australia: Pileus conico-cylindrical, 7-16ths inch high and 5-16ths inch broad, then conico-campanulate, then convex and up to 1 inch broad, the centre finally dimpled, darkish brown in the centre, succeeded by a pallid biscuit-coloured disc, the rest of the pileus plicate and greyish biscuit-coloured, a few glistening particles present, membranaceous; gills close, narrow, ascending, just reaching the stem and attached to a collar, greyish, edges white; stem $1\frac{1}{2}$ to $3\frac{1}{2}$ inches high, slender, slightly attenuated upwards, hollow, white; spores dark brown to black, 12·5 to 16×7 to 10 μ. On the bare ground or amongst grass or garden plants, Beaumont, May, June; Waterfall Gully, Sept. (Herb., J. B. C., Form. Sp., No. 328). A sterile form was found at Beaumont in May at the same time as fertile specimens and at first suggested a *Galera*. The pileus and gills were yellowish-brown from the absence of spores (Form. Sp., No. 329).

MONTAGNITES.

422. *Montagnites Candollei,* Fr. In identifying a specimen for us, C. G. Lloyd states that he considers that "there is but one species (of this genus), widespread in sandy countries, varying as to stature and spore size, but all one. All have a volva if perfect." This being Lloyd's opinion, we place all our plants under this specific determination, though they vary considerably. We append short descriptions of the forms met with:—

(a) Stem slender, up to 2 inches high, sometimes attenuated upwards, fibrous-scaly, striate, firm. Volva definite, nearly clasping the base of the stem, the free edge jagged. Expanded disc-like upper portion of the stem up to $1\frac{1}{2}$ inches in diameter, plane or convex and dimpled. Gills up to $\frac{3}{8}$ inch long, curved downwards. Spores black or dark purplish, elliptical, one end more pointed, 15 to 24×9·5 to 12 μ, rarely 27×21 μ. South Australia. Miller Creek, near Mount Eba, Central South Australia, Aug. (Dr. T. Campbell; identified by Lloyd, No. 791); Ooldea, Aug., a number of specimens in sandy soil. Western Australia: Kurrawang (Mrs. A. F. Cleland).

(b) Similar to the above, but longer (3 inches) and generally larger; spores blackish to dark brown, elliptical to irregular or almost triangular, 7·5×5·5 μ. On a sandhill, Waitpinga, Encounter Bay, Jan.

(c) A coarse plant. Stem $3\frac{1}{2}$ inches high, attenuated upwards, $\frac{1}{2}$ inch thick in the middle, in the middle part with several broad, thick, veil-like dependent bands with texture firm and corky and brownish-straw in colour. No volva now detectable. Disc-like expansion of the stem $\frac{3}{4}$ inch in diameter, convex. Spores dark purple, spherical, smooth, 5·4 to 6·4 μ. Miller Creek, near Mount Eba, Aug. (Dr. T. Campbell). We have only the one, slightly injured, specimen of this form. It seems undoubtedly to be a *Montagnites,* but it seems to us to be probably specifically different from our other specimens. Till more material is available we, however, leave it under *M. Candollei.*

Several years ago, at Forbes, in New South Wales, we collected a fungus (which has been mislaid) which we now believe to have been *M. Candollei.* It had black spores and at the time suggested to us a rapidly dried *Coprinus.*

POLYPORACEAE.

Fistulina.

423. *Fistulina hepatica*, Fr. Cke., Hand. Austr. Fungi, No. 582 (W. Austr.). Vict.: Cuticle rough and brown with a red tinge, flesh translucent with white striae running through it, pores of a delicate flesh-pink, a few oval pale yellowish-brown spores seen 7 to 8×5·2 μ, at foot of an old decayed stump, Ararat, May (E. J. Semmens, No. 83). South Australia: Rather flabelliform in shape, 3 inches deep and wide, dark brown (near Rood's Brown, xxviii.), villous; pores near Japan Rose (xxviii.), the tubes separate, coral pinky-brown, then brownish-pink; flesh shows brown and paler layers; spores whitish, 4·8×3·2 μ; on dead stumps and at the base of Eucalypts, Mount Lofty, June, 1921.

Strobilomyces.

424 (iii., 158). *Strobilomyces pallescens*, Cke. and Mass. N.S. Wales: When quite young, pileus globose, ¾ inch in diameter, constricted round the stem, the periphery expanding a little and projecting from the stem, the stem 3 inches high, attenuated upwards. When adult, the pileus up to 2½ inches in diameter, slightly convex, shaggy, or broken up into large scale-like warts, some ½ inch in diameter and very thick with fissures between them, the tops of the warts dirty brown, the bases almost crimson-lake in colour, the warts somewhat polygonal in shape and in arrangement resembling a pine-apple, the pale straw-coloured flesh exposed in the cracks, when young the pileus floccose from felted fibrils aggregating to form early scales, colours noted when young Pale Flesh (Dauthenay, pl. 136, ton 4) to browner and darker than Pale Blush (pl. 137, ton 4), when older with pinkish-purple marks. Hymenial surface convex, the middle tubes up to ½ inch long, shortening inwards and outwards, just adnexed and almost free, pores fairly large, angular, bright yellow to yellowish-brown becoming dark. Veil marked when young, turned downwards on to the stem and forming a narrow sleeve adpressed to this, rupturing to leave long, jagged, dirty-straw-coloured streamers round the edges of the pileus, rather scaly, in parts tinted pinkish-purple. Stem up to 3 to 6 inches high, markedly bulbous, attenuated to ½ inch in diameter in the middle, dirty white in colour, often pinkish-purple to a dull crimson-lake tint above and the lower part sometimes greyish, solid, when not quite mature with numerous ring-like remains of the veil on the stem. Flesh of the pileus turning blue on section, that of the stem reddish. Spores yellow-brown, 19 to 20·5×7·2 to 9 μ. At or near the base of *Angophora lanceolata*, Cav., Neutral Bay, March, and Bradley Head, April.

425 (iii., 159). *Strobilomyces floccopus*, Rost. N.S. Wales: Kendall, May, spores pear-shaped, dark brown, reticulated, 8·5 to 10·4×7 to 8·5 μ.

Boletus.

426. *Boletus luteus* (L.). In all cases, under or near species of *Pinus*. Spores mummy-shaped, brown, 7·6 to 11×3·2 to 5 μ. N.S. Wales; Mittagong, June (ring marked). South Australia: Beaumont, Adelaide, May; Walkerville, Adelaide, Sept.; Green Hill Road, July (after heavy rain, at first intensely glutinous and almost white with an ample white veil, becoming dirty brown on the veil and pileus, the cut base of the stem turning brownish); Mount Lofty, April, June (young specimens were eaten and proved palatable); Upper Sturt and National Park (also forms without a ring), May; Kuitpo, May (also forms without a ring).

427. *Boletus megalosporus*, Berk. Clel. and Cheel, Proc. Roy. Soc. N.S. Wales, xlviii., 1914, p. 44. N.S. Wales: Pileus up to 2½ to 4½ inches in diameter,

covered with a fawny meal or villous becoming smooth, then sticky or viscid even when nearly dry so as to adhere to paper, convex, easily indented, pale tan to reddish-brown (tints noted—Maize Yellow, Dauthenay, pl. 36, ton 4; Fawn, pl. 308, ton 1). Pores small to rather large, whitish, then flesh coloured, pallid brown or pale fleshy-brown (paler than Madder Brown, Dauthenay), the tubes up to $\frac{1}{2}$ inch long, with a sulcus round the stem. Stem $2\frac{1}{2}$ to 4 inches high, rather slender ($\frac{1}{2}$ inch to $\frac{5}{8}$ inch or more below), attenuated upwards, whitish or with tints of brown (Creamy White, Dauthenay), deeply and irregularly elongated, lacunose throughout, rooting with mycelial threads at the base, with spongy pith or markedly hollow. Spores mummy-shaped, smooth, brownish, 13·8 to 19×5 to 6·5 μ. Taste bitter. N.S. Wales: National Park, May (Miss Clarke, Watercolour); Chatswood, May; under *Casuarina*, North Bridge, Sydney, April (edge of the pileus inturned with attached remains of a veil). This species in general appearance resembles *B. lacunosus*, Cke. and Mass., but the spores differ markedly. We have had difficulty also in separating some examples of our *B. austro-felleus* when the reticulations become above almost areolate or lacunose.

428. *Boletus lacunosus*, Cke. and Mass. Clel. and Cheel, Proc. Roy. Soc. N.S. Wales, xlvii., 1914, p. 441. N.S. Wales: Pileus soft, pores adnate, base of the stem or the whole stem lacunose, spores warty, swollen in the middle with pointed ends, yellowish-brown, 12 to 13×6·5 to 6·8 μ. Colour tints noted:—Plieus tints of Buff Pink to Onion-skin Pink (Ridgway, xxvii.), Pale Ecru (Dauthenay, pl. 66, ton 4); pores near Light Russet Vinaceous (Ridgway, xxxix.), Lilacy White (Dauthenay, pl. 7, ton 4); stem Maize Yellow (Dauthenay, pl. 36, ton 2); National Park, May.

429. *Boletus (Tyropilus) austrofelleus*, n. sp. Pileus 2 to 5 inches in diameter, irregularly convex to nearly plane, slightly viscid when moist, villous or matt when dry, sometimes feeling like soft leather, Mineral Brown (Dauthenay, pl. 339, tons 1 and 2), dull pale brown, cinnamon-brown, dark reddish-umber, rich reddish-brown to dark tan, pale brown with a pinkish tinge or dark rusty-brown to a little yellower than Burnt Umber (pl. 304, ton 1). Pores rather pallid with a flesh tint, pinkish-tan, pinkish-brown or fleshy-brown, turning reddish-brown or brownish, small, adnate or with a slight sulcus round the stem, the tubes $\frac{1}{4}$ to $\frac{3}{4}$ inch long, attenuated both ways, pallid fleshy-brown (a little darker than Rosy White—Dauthenay, pl. 8, ton 4), or pale wood colour, sometimes showing a greenish tinge. Stem 2 to $3\frac{1}{4}$ inches high, up to 1 inch thick, sometimes slightly attenuated downwards or slightly thickened below, the root somewhat pointed, above pale brownish with darker reticulated lines and below darker brown and sometimes punctate with brown dots or the colour dark pinkish-brown or reddish-brown; sometimes the stem is streaked and not reticulated. Flesh up to $\frac{3}{4}$ inch thick, whitish, usually turning slightly reddish-brown. Taste usually mild, in one case noted as slightly bitter and only in one as very bitter. Rather strong radishy smell. Spores elongated mummy-shape, almost white to pale brown, 10·4 (rarely 8·5) to 14 (rarely 15·5)×3·4 to 5·5 μ. Brown cystidia seen in one collection (at the base of an old stump), ventricose, 34 to 38×12 μ. N.S. Wales: Sydney (Neutral Bay, Mosman, etc.), March, April, May, Dec.; Milson Island, Hawkesbury River, April (Miss Clarke, Watercolours Nos. 62 and 200; D. I. Cleland, Watercolour No. 7). The following differ slightly:—Pileus, soft almost like cotton-wool and easily indented, viscid with an easily separable cuticle leaving a white flesh, the colour of a yeast bun but paler yellowish-brown at the periphery; pores rather hexagonal, moderately large, about 7 in ·5 cm., of a dingy fleshy-brown; the stem below striate by slightly raised vaguely anastomosing brownish lines, taste mild, spores pale tinted, 11 to

$12 \times 4 \cdot 2\ \mu$; Neutral Bay, April—these specimens resemble *B. megalosporus*, Berk., except that the stem is not lacunose but only vaguely reticulated and the spores are smaller. Other specimens collected also at Neutral Bay in April are noted as having a slightly curved pileus, not viscid but feeling like a kid glove; adnate pinkish-flesh tubes; the stem streaked but not reticulated; the spores pallid, $10 \cdot 4$ to $13 \cdot 8 \times 4\ \mu$; and the taste very bitter. Large specimens collected at Bradley Head in April, had stems which were reticulated and almost areolate or lacunose above, in colour near Burnt Umber (Dauthenay, pl. 304, ton 2), spores pallid, $13 \cdot 8$ to $15 \cdot 5 \times 5\ \mu$. This species would seem almost to grade into *B. megalosporus*, Berk. In fact, we placed the last-mentioned specimens at first under the latter species.

Pileus 5 ad 12·5 cm. latus, irregulariter convexus ad subplanus, subviscidus, exsiccatus subtomentosus, fuscus, cinnamoneo-fuscus, rubido-fuscus, vel pallido-fuscus. Porae subparvae, carneo-pallidae, deinde rubidae adnatae vel peri stipem parvo sulco, tubulae 6-18 mm. longae, bifariam attenuatae, pallido-carneo-rubidae. Stipes 5 ad 9 cm. longus, ad 2·5 cm. crassus, sursum pallido-fuscus et lineis reticulatis, deorsum fuscus et punctatus vel rubido-fuscus. Caro ad 18 mm. crassus, albidus, saepe mutans subrubidus. Sapor fere mitis, rariter acerbus. Sporae elongato-fusiformes, albidae vel pallido-rubido-albidae, fere 10·4-14, rariter $8 \cdot 5$-$15 \cdot 5 \times 3 \cdot 4$-$5 \cdot 5\ \mu$.

430. *Boletus (Gyroporus) caespitosus*, n. sp. Caespitose. Pileus up to 4 inches or more in diameter, convex and wavy, sometimes with the surface cracking, surface matt, dull and soft but sometimes rather shiny, Cinnamon Buff to Clay Colour (xxix.) or near Isabella Colour (xxx.). Pores rather small, beginning as minute, irregular reticulations, rather irregular, dissepiments thick, with a sulcus round the stem, pallid brownish-white or the colour of the cap (near Ivory Yellow, xxx.), becoming pale wood colour when bruised, old or cut, tubes up to $\frac{1}{4}$ inch to $\frac{1}{2}$ inch long, attenuated both ways. Stem up to $3\frac{1}{2}$ inches high, swollen in the middle (up to $1 \cdot \frac{5}{8}$ to 2 inches), up to $\frac{3}{4}$ to 1 inch thick above and to $1 \cdot \frac{1}{8}$ to $1\frac{1}{2}$ inches below, surface matt, the colour of the pileus, punctate with fine brownish granules. Flesh thick (up to 1 inch), white turning brownish or yellowish-brown. Spores oval to subspherical, white or slightly tinted, 8 to $8 \cdot 9 \times 5$ to $5 \cdot 5\ \mu$. Moderately strong smell, taste mild. South Australia: At the base of a dead *Eucalyptus rostrata*, Schl., stump on successive years, Burnside, Adelaide, May; National Park, May. N.S. Wales: Terrigal, June (stem bulbous, spores with a central gutta).

Plantae caespitosae. Pileus ad 10 cm. latus vel plus, convexus et undulatus, mollis et non-nitidus, interdum subnitidus, cinnamoneo-luteus vel isabellinus. Porae subparvae, subirregulares, dissepimentis crassis, peri stipem sulco, eburneo-luteae, tubulae ad ·6-1·2 cm. longae. Stipes ad 8·7 cm. altus, in media parte inflatus, coloribus simillibus pileo, punctatus granulis. Caro crassus, albidus, mutans sub-brunneus. Sporae ovales ad subsphericales, albidae, 8-$8 \cdot 9 \times 5$-$5 \cdot 5\ \mu$.

431. *Boletus ovalisporus*, n. sp. Pileus $2\frac{1}{4}$ inches broad, irregularly convex to upturned, surface matt, tinted with shades of yellow and red, more yellow in the centre and more reddish round the periphery. Pores rather small, with a sulcus round the stem, tubes $\frac{1}{4}$ inch deep, mustard-yellow. Stem 1 inch high, $\frac{1}{2}$ inch thick, slightly attenuated downwards, surface matt, stained yellow. Flesh turning yellow and in places reddish or bluish. Spores oval, slightly brown, $7 \cdot 5 \times 5\ \mu$. South Australia: Kuitpo, May, 1921. Vict.: Mr. E. J. Semmens has sent me (No. 73) what is from the dried specimens and his notes obviously the same species. He says: "Under Eucalypts *(E. melliodora*, Cunn.) and in long grass *(Poa caespitosa*, Forst., and *Anthistiria ciliata*, L.) and young growth of

E. elaeophora, F. v. M., Ararat, May, 1919. Whole plants at times with blood-red marks on the cap and in places on the pores and stem." Spores oval, nearly colourless, 7 to $8 \cdot 5 \times 5 \cdot 2$ to 6 μ.

Pileus 5·5 cm. latus, irregulariter convexus ad recurvatus, non-nitidus, flavus et ruber. Porae subparvae, peri stipem sulco, tubulae 6 mm. longae, sinapido-flavae. Stipes 2·5 cm. altus, 6 mm. crassus, subflavidus. Caro mutans flavidus et interdum rubidus vel cyaneus. Sporae ovales, subfuscae, $7 \cdot 5 \times 5$ μ.

432. *Boletus portentosus,* Berk. and Br. Cke., Hand. Austr. Fungi, No. 563 (Vict.). An exceptionally large *Boletus* which we have met with in New South Wales, and recently also in South Australia, seemed from the description to be this Ceylon species already recorded as above for Victoria. To make certain as far as possible, I wrote in 1919 to Mr. T. Petch at Peradeniya, Ceylon, sending him some dried specimens. In replying he kindly furnished a copy of the original watercolour painting, which agrees very closely with the Australian specimens. The spores he found were similar, but noted that our plants appeared to be minutely tomentose (which is the case), whilst his notes on the Ceylon species stated that the pileus was glabrous. In Petch's redescription of this species (Annals Roy. Bot. Gdns., Peradeniya, iv., 1907, p. 58) the pileus is described as smooth and the stem as lacunose. He considers the dried type specimens of *Polyporus olivaceo-fuscus,* Berk. and Br., which the authors described with a pileus which was "pulverulento-tomentoso" as being immature plants of *B. portentosus.* It is probable, then, that young Ceylon plants are sometimes tomentose. With the exception of the lacunose stem, our plants thus agree remarkably well with Petch's description, and so we consider them to be *B. portentosus,* or at most an Australian variety.

A composite description of the Australian plants is as follows:—Pileus 11 to 15 inches (South Australian specimens) in diameter, convex to nearly plane, sometimes with the centre a little depressed, finely tomentose or flecked with brownish to greenish-brown fibrillose scales, tending to crack, brown with a greenish tinge or dingy yellowish olive (tints approaching Brown Pink, Dauthenay, pl. 297, ton 1, and browner than Bistre Green, pl. 296, ton 1). Flesh up to 2 inches thick, whitish but slightly dingy, sometimes turning yellowish with shades of sagey-green or bluish-green and around insect marks and sometimes in the stem reddish, soft in texture like firm cotton-wool and difficult to cut from its punkiness. Tubes $\frac{3}{4}$ to $1\frac{1}{4}$ inches long, just reaching the stem but leaving a slight sulcus, pinkish-orange-yellow or yellowish-green, becoming dark brown when old or injured (near Chrome Yellow, middle, Golden Yellow, pl. 26, ton 1, with reddish stains), orifices moderately large, rather irregular. Stem sometimes eccentric, up to $7\frac{1}{2}$ inches long, very stout, up to 7 inches thick in the middle, $5\frac{1}{2}$ inches thick above, bulbous, ending below in a short conical root, mouldy-looking green with tints of yellow and brown or dingy yellowish-brown (tints of Old Olive Green, Olive Brown, pl. 299, tons 1 and 2), darker below, punctate looking from groups of villosities, not reticulated. Spores obliquely elliptical or pear-shaped to oval, brownish, 7 to $8 \cdot 5 \times 5$ to 6 μ. Taste mild. N.S. Wales: Chatswood, Feb., 1918 (Miss Clarke, Watercolour No. 175); National Park, March; Bulli Pass, April; Lisarow (C. H. Starkey), Oct.; Mount Irvine. South Australia: Bull's Creek (spores yellow-brown, elliptical, 8·5 to $9 \times 5 \cdot 6$ μ).

433. *Boletus (Phaeoporus ?) lilacino-brunneus,* n. sp. *B. prunicolor,* Cke. and Mass., whose description this species somewhat resembles, has, if correctly described, much larger spores (18 to 20×6 μ). There is some resemblance also to the description of *B. intractus,* Fr. (Cke., Hand. Austr. Fungi, No. 564, W.A.), but the pores are hardly sulphur coloured. This species is common in places near Sydney and frequently remains long unexpanded. Pileus $\frac{3}{4}$ inch up to $3\frac{1}{2}$ inches

in diameter in expanded specimens, convex, then slightly convex with the centre raised or irregularly plane, somewhat viscid when moist, when dry surface dull or finely villous and showing with a lens adpressed fibrils, sometimes splitting to show the white flesh, pale biscuit in colour to lilacy-brown, dull carnation or brownish-purple (browner than Lilac, Dauthenay, pl. 176, ton 4, with the edge Rosy White, pl. 8, ton 4; Dark Fawn, pl. 307, ton 4, to Burnt Umber, pl. 304, ton 2; deeper than Lilacy White, pl. 7, ton 4, flecked with Dark Chocolate Brown, pl. 342, ton 2). Pores adnate to adnexed and leaving a sulcus round the stem, then separating, minute, very crowded, dissepiments thick, the tubes very shallow, whitish to pale yellow or pale flesh (the tubes a deeper flesh) (Rosy White, pl. 8, ton 1, passing to ton 4 on bruising; Purplish-tinted White, pl. 6, ton 4; Amber White, Succinum (Yellow), pl. 12, ton 4). Stem $1\frac{3}{4}$ to 4 inches high, stout to moderately slender, up to 1 inch thick in the middle, base bulbous or a little swollen, solid, coloured like the pileus but not so dark and more streaky or sometimes punctate, dull carnation to lilacy-brown (browner than Lilac, pl. 176, ton 4; Purplish White, pl. 6, ton 4 above to Pinkish Neutral Tint, pl. 361, ton 1, below; near Fleshy White, pl. 9, ton 4, streaked with Dark Chocolate Brown, pl. 342, ton 3). Flesh thick, white, sometimes turning a little pink. Taste mild. Spores in the mass Lilacy White (pl. 7, ton 2), after keeping becoming browner with a purplish tint, microscopically pallid to brownish, mummy-shaped, sometimes deformed or long and narrow, 8·5 to 13×3·4 to 5 μ. N.S. Wales: Neutral Bay, Bradley Head, etc., round Sydney Harbour, Feb., March, April, May; Narrabeen, Newport (Dr. Darnell-Smith), March; National Park, March. A collection of expanded examples, apparently of this species, obtained at Bradley Head in April, had yellowish pores, turning bluish-green when bruised and the flesh of the pileus and stem turning yellow, then a rich blue (Pale Blush, pl. 137, ton 4; Maize Yellow, pl. 36, ton 4; Pale Ecru, pl. 66, ton 4; later blue). (Form. Sp., No. 75.)

Pileus 1·8 ad 8·7 cm latus, saepe non-expansus, convexus, deinde subconvexus vel irregulariter planus, subviscidus, exsiccatus subvillosus et adpresso-fibrillosus, lilacino-brunneus sed variabilis. Porae adnatae vel adnexae, peri stipem sulco, deinde disjunctae, minutae, dissepimentis crassis, tubulae perbreves, albidae vel roseo-albidae vel succineo-albidae. Stipes 4·5 ad 10 cm. altus, crassus ad subtenuis, base bulboso vel sub-bulboso, solidus, similis pileo coloratus, interdum punctatus. Caro crassus, albidus. Sporae lilacino-albidae, deinde subfuscae, fusiformes, 8·5-13×3·4-5 μ.

POLYPORUS.

434. *Polyporus pelles*, Jarvis. Lloyd, in Apus Polyporus, p. 327 (Q'land); Clel. and Cheel, Jour. Proc. Roy. Soc. N.S. Wales, li., 1918, p. 528, No. 130. Syn. *P. atrohispidus*, Lloyd, Mycol. Notes, No. 58, March, 1919, p. 823. fig. 1376. Upper surface Russett (xv.) to Mars Brown (xv.) or near Bay (ii.) with paler areas, villous to hispid with brownish fibrils often in fascicles and sometimes scattered and showing the whitish fibrous surface below, nearly plane to slightly convex, up to $4\frac{1}{4}$ inches broad by 3 inches antero-posteriorly. Contracted sometimes into a narrow, short, stem-like base, but usually broadly and somewhat decurrently attached by one-third or more of its border. Under surface convex. Pores minute, close, irregular, dissepiments thin, whitish, pallid or with a pale ochraceous tinge, when bruised or older turning Russet (xv.), the tubes when cut Pale Ochraceous Salmon (xv.), becoming Russet (xv.), occasionally $\frac{1}{2}$ inch deep. Context radiately strigose, Pale Ochraceous Salmon becoming Russet, up to 1 inch thick at its attachment, gradually attenuating outwards. Flesh easily cut, softish but coherent. Spores abundant, elliptical, one side a little flattened,

white to pallid, some coloured brownish, 4·5 to 7·5 by 3·2 to 4 μ. On living and dead Eucalyptus trunks and stumps. N.S. Wales: National Park, May (identified by Lloyd, Nos. 183 and 523). South Australia: *Atrophispidus* form, on trunks of living *E. obliqua,* L'H., and on dead stumps, Mount Lofty, June and July (identified by Lloyd, No. 788), and National Park, Aug.; *pelles* form on *E. obliqua,* L'H., and dead stumps, Mount Lofty, May (identified by Lloyd, No. 789), and Kuitpo.

435. *Polyporus Victoriensis,* Lloyd. Lloyd (No. 846) has identified for us as this species plants found on a dead Eucalypt in the National Park, South Australia, in September, 1922. There were abundant subspherical whitish spores, 3·2 to 3·8 μ. No setae were seen. Lloyd has described our specimens as follows:—"Pileus sessile, large, 5×8 inches and 3 inches thick, ligneous, suggesting a *Fomes.* Surface with thin, pale, glabrous crust. Context brown. Pores about 1·5 cm. long, coarse to the eye, brown, the mouths darker. Setae none. Hymenial elements hyaline. Spores hyaline, globose, 4 μ, smooth." He considers our plant as a perfect specimen of the species he had previously described from Victoria on an imperfect specimen, and places the species in Sect. 95 of his Apus Polyporus, differing from the *P. gilvus* section (Sect. 96) in the absence of setae.

436. *Polyporus sordentulus,* Mont. N.S. Wales: Radiating from a common centre, on the ground, probably on an old stump, spores (?) 3·4 by 2 μ, Kendall, May (identified by Lloyd, No. 345).

437. *Polyporus concrescens,* Mont. . N.S. Wales: Boatharbour, near Lismore, Aug. (identified by Lloyd, No. 417).

438. *Polyporus trabeus,* Fr. Placed by Lloyd in his Div. I., Sect. 81. N.S. Wales: On fallen trunk, National Park, May, spores rod-shaped, slightly curved, 3·5 to 4·2 by 1 μ (identified by Lloyd, No. 529, "in sense of my Apus Pamphlet"); on fallen trunk, Lisarow, when moist soft, white, surface a little dingy and rather velvety, pores do not change colour, spores numerous, white, 5·5 by 3·8 μ (identified by Lloyd, No. 455: "I make the spores allantoid").

439. *Polyporus rubidus,* Berk. Cke., Hand. Austr. Fungi, No. 640 (Q'land, N.S. Wales); Clel. and Cheel, Jour. Proc. Roy. Soc. N.S. Wales, li., No. 12. N.S. Wales: Kendall, Aug. (identified by Lloyd, No. 565).

440. *Polyporus citreus,* Berk. Lloyd, Syn. Apus Polyp., p. 355: Lloyd, Letter 67, Note 659. N.S. Wales: National Park, July; Macquarie Pass, Aug. Identified by Lloyd (No. 422) with some doubt. He points out that the type at Kew is very small, and that he was in error in placing this species in Div. IV., Sect. 98, as the spores are evidently not coloured. He gives the colour of our specimens as Amber Yellow of Ridgway.

Fomes.

441 (iii., 185; iv., 305). *Fomes robustus,* Karst. Spores subspherical to rather triangular, hyaline, 6·3 to 8μ. Vict.: Staughton Vale, Brisbane Ra., Nov. (occasional narrow, acuminate, brown setae, 14·5 by 3 μ). South Australia: On *Eucalyptus viminalis,* Labill, Magill, June; National Park, Sept., and Kuitpo, May; on *E. ovata,* Labill., Kuitpo, March (two trees affected, one with a number of brackets and sick-looking), and between Willunga Hill and Myponga, Nov. (many trees affected); on *Casuarina stricta,* Ait., Encounter Bay, Jan. (occasional nearly colourless but slightly tinted oval spores, 9 by 7 μ, and occasional brown setae with swollen bases, 27 by 10 μ); at base of tree, Clare, Aug.; L. Bonney, S.E., Dec., and Port Lincoln, May; on *Callitris robusta,* R. Br., Kinchina, Sept.

442 (iv., 310). *Fomes rimosus,* var. *Casuarinae,* Clel. and Cheel. Spores subspherical to oval, brown, 6·5 to 7·5×4 to 5 μ. South Australia: On belah,

Casuarina lepidophloia, F. v. M., and on mallee, *Eucalyptus oleosa*, F. v. M., Renmark, Jan.; on *E. odorata*, Beh., Kinchina, Oct.; on *C. lepidophloia*, F. v. M., Oak Forest, Ooldea, Aug., and Dilkera, May (Prof. Osborn); on *C. stricta*, Ait., Clare, Aug.

443 (iv., 313). *Fomes (Ganodermus) applanatus*, var. *leucophaeus*, Mont. We have recorded *F. applanatus*, Pers., for South Australia, but the form found in this State is probably this variety with a pallid crust. Mr. J. A. Hogan collected a large specimen (21 inches laterally × 8 inches × 3 inches thick) at the butt of an old pepper tree *(Schinus mollis)* at Burnside in April, 1924. The crust is pallid brownish to brownish, the context up to $1\frac{1}{2}$ inches thick, and the pore layer $\frac{1}{4}$ to 1 inch thick. The latter for the most part shows evident seasonal additions to the tube length of small amount, though in one part a tube length of $\frac{3}{4}$ inches has been attained apparently in one growing period. These specimens are in obvious contrast to the usual New South Wales ones, with relatively scanty context and exceedingly long tubes (var. *australis)*, the difference corresponding to the difference in rainfall (in total amount and seasonably distributed).

Polystictus.

444 (iii., 170; iv., 292). *Polystictus cinnabarinus*, Jacq. South Australia: On peppermint gum, O'Halloran Hill, Aug. (G. H. Dutton); on dead stumps of *Callitris robusta*, R. Br., Murray Bridge, Sept., 1889 (Mr. Zietz); on bunya-pine wood, *Araucaria Bidwilli*, Hook., Burnside, Aug. Western Australia: Kalgoorlie.

Hexagona.

445 (iv., 315). *Hexagona Gunnii*, Hook. Spores elongated, 16 to 24, usually $19 \times 6{\cdot}5$ to 8 μ. South Australia: Hills above Glen Osmond, April; National Park, May; Mount Lofty, June; on *Eucalyptus viminalis*, Labill., Victor Harbour, Aug.

THELEPHORACEAE.

Stereum.

446 (iii., 219; iv., 335). *Stereum membranaceum*, Fr. South Australia: At base of *Casuarina lepidophloia*, F. v. M., Dilkera, May (Prof. Osborn).

Craterellus.

447. *Craterellus multiplex*, Cke. and Mass. Cke., Hand. Austr. Fungi, No. 967 (Tas.). South Australia: At the base of a dead stump, Mount Lofty, June, upper surface of the pilei Light Pinkish Cinnamon (xxix.), the hymenial surface near Vinaceous Pink (xxviii.) of narrow thick radiating folds, sometimes forking or connected by bars.

GASTEROMYCETALES.

Phalloideae.

448. *Phallus rubicundus*, Fisch., var. *gracilis*. Clel. and Cheel, Jour. Proc. Roy. Soc. N.S. Wales, xlix., 1915, p. 199. Miss L. Greenberger, Head Teacher at Mount Benson School, near Kingston, S.E., has forwarded through Mr. A. G. Edquist specimens of this species, collected in April and June in a sandy place amongst buffalo grass. The spores are rod-shaped, $5{\cdot}5 \times 2$ μ. This is the first record of the genus for South Australia.

449. *Lysurus australiensis*, Cke. and Mass. Under the specific name of *L. Gardneri*, Berk., a Ceylon species, we have previously (Jour. Proc. Roy. Soc. N.S. Wales, xlix., 1915, p. 204) described a number of Australian plants. From

recent careful work by T. Petch it is clear that the Australian plant is a different species, and so we revert to Cooke and Massee's name, which in the above paper we suppressed as a synonym. N.S. Wales: In buffalo grass lawn, Narrabri, May, 1919; Palm Beach, April, 1918, lobes dirty orange. South Australia: Plants up to 6 inches high. Arms 5, 1 inch long, upright but slightly spreading above, somewhat triangular, narrowing upwards, external surface Light Pinkish Cinnamon (xxix.) or Ochraceous Orange (xv.) and longitudinally grooved, the groove continuous with the stem, the inner surface covered with the dark brown gleba, more or less transversely rugose and the rugae occasionally anastomosing and encroaching on the sides of the external groove and passing between the arms, where the pileus is represented merely by a narrow rim, the arms hollow with the inner surface folded to correspond with the depressions in the outer surface. Stem attenuated downwards, tapering into the volva, $\frac{1}{3}$ inch thick below, $\frac{1}{2}$ inch thick above, finely furrowed more or less longitudinally, leaving somewhat elongated depressions between the furrows, some of these penetrating deeply and forming slightly elongated lacunae, white below gradually passing into Cream Buff (xxx.) above, hollow with the cavity $\frac{1}{4}$ in. in diameter and narrowed but open above and below, the wall of two layers of cells, the inner the larger. Volva white, lax, torn irregularly into lobes. Smell sickly faecal. Spores $4{\cdot}5 \times 2\ \mu$. On a lawn at the Grange, Jan., Feb., and April, 1924 (Mrs. Kelly, per H. Finnis, Editor of the Journ. of Agric., South Australia).

NIDULARIACEAE.

Nidula.

450. *Nidula microcarpa*, Peck. Lloyd (The Nidulariaceae, 1905, p. 11) refers an Australian collection made by Reader, probably in Victoria, to this species (probably). We have found a single plant, which also seems referable to this species, between Bowral and Robertson, New South Wales, in August. The outer surface of the peridium is adpressed-tomentose and pallid. There are numerous, very small, dark reddish-brown peridioles, the surfaces of which are very slightly rugulose. The spores are 9 to $10{\cdot}4 \times 5{\cdot}5$ to $6{\cdot}8\ \mu$.

Cyathus.

451 (iv., 350). *Cyathus stercoreus*, Schw. N.S. Wales: Hawkesbury River, June, July. South Australia: On dung, Mount Lofty, May; by roadside, Green Hill Road, June.

452. *Cyathus vernicosus*, Tul. Clel. and Cheel, Proc. Roy. Soc. N.S. Wales, l., 1916, p. 107. Spores $9{\cdot}5$ to $12{\cdot}5 \times 4{\cdot}5$ to $8\ \mu$. Vict.: On decaying bark, Craigie, near Ararat, June (E. J. Semmens). South Australia: Adelaide, Feb. (A. H. C. Zietz); Mount Lofty, June; Islington, June (E. H. Ising); on fallen leaves and sticks, Beaumont, June (identified by Lloyd, No. 785) and July; New Brighton, Sept. (D. Gibbons).

453. *Cyathus Colensoi*, Berk. Lloyd, The Nidul., p. 26. South Australia: Lloyd (No. 790) has identified specimens for us collected by Dr. T. Campbell in August between Mount Eba and the North-South line. The outer surface of the peridium is whitish. In young specimens the adpressed hairs on the exterior are prominent. The spores are pear-shaped, $9{\cdot}6 \times 8\ \mu$. We have also collected specimens at Ooldea Soak in August; spores variable, $14{\cdot}5 \times 8\ \mu$, $9{\cdot}5\ \mu$, $9{\cdot}5 \times 6{\cdot}5\ \mu$.

ASCOMYCETALES.

454 (iii., 237). *Leotia marcida*, Pers. South Australia: Amongst leaves under trees, Mount Lofty, June, stem near Yellow Ochre (xv.), pileus near Medal Bronze (iv.). Spores slightly curved, 15 to 19×4 to $5\ \mu$.

ADDITIONS TO THE FLORA OF SOUTH AUSTRALIA.
No. 22.

By J. M. Black.

[Read October 9, 1924.]

Gramineae.

Eragrostis interrupta, (Lamk.) Beauv. var. **tenuissima,** Stapf. Dr. Stapf distinguishes *E. interrupta* from *E. tenella,* (L.) Roem. et Schult., by the former having 2 stamens and the latter 3. Our far-northern grass (which also occurs in India and China) has only 2 stamens, and he therefore places it as above, instead of under *E. tenella.*

Eragrostis interrupta, (Lamk.) Beauv. var. **densiflora,** n. var. Variat paniculâ erectâ spiciformi 6-10 cm. longâ basin versus interruptâ, ramis 5-20 mm. longis dense fasciculatis et secus rhachin principalem appressis usque ad basin spiculis vestitis, spiculis subsessilibus 2-3 mm. longis 4-5-floris, glumâ floriferâ 1 mm. longâ, paleâ glabrâ, staminibus 2, caryopsi ovoideâ nitente ½ mm. longâ.

Toorawatchy Waterhole, between Cordillo Downs and Innamincka; coll. J. B. Cleland. Has a very different appearance from var. *tenuissima* because of the compact spikelike panicle, with appressed branches shorter and much more densely clothed with spikelets.

Isachne australis, R. Br., has been found by Professor Cleland at Black Swamp, near Currency Creek.

Cyperaceae.

Cyperus Eragrostis, Vahl., has been re-discovered by Professor J. B. Cleland in a marsh near the Bluff, Victor Harbour.

Var. **pauperata,** n. var. Variat caule tantum 1-3 cm. longo verisimiliter annuo tantum 1 vel 2 spiculas gerente, involucri bracteis 2, alterâ breviore alterâ multo longiore quam spicula.

Spring behind the Bluff; coll. J. B. Cleland. Our specimens show a minute plant, with spikelets of the type, but much reduced in number.

Cyperus Clelandii, n. sp. Perennis, caule subrobusto 50-80 cm. longo apicem versus trigono, foliorum vaginis latis scariosis laminis angustis caulem subaequantibus margine scabris, umbellae compositae radiis primariis circiter 8 3-10 cm. longis, radiis secundariis alternis divergentibus inaequalibus base bracteatis apice 3-10 spiculas glomeratas stellatim patentes gerentibus, spiculis linearibus compressis aureis 6-9 mm. longis 2 mm. latis 8-12-floris, involucri bracteis circiter 5 quarum 3 vel 4 inflorescentiam longe superantibus, glumis 2 mm. longis mucronulatis utroque latere 3-4-nerviis, rhachillâ diu persistente angustissime alatâ, nuce angustâ trigonâ acutâ stramineâ sub lente granulatâ glumae fere aequilongâ.

Cordillo Downs, north of Cooper Creek; fruiting May, 1924. Named after the finder, Professor J. B. Cleland, who made a large collection of plants in the Far North-East during May and June, 1924. Differs from *C. longus,* L., *C. rotundus,* L., *C. tuberosus,* Rottb., *C. stolonifer,* Retz., and *C. disruptus,* C. B. Clarke, in the nut nearly as long as the fruiting glume, instead of only ⅓ or ½ as long. In other respects it comes nearest to descriptions of *C. tuberosus,* but the spikelets are shorter and fewer-flowered, the glumes much shorter and distinctly 3-4-nerved on each side. The ripe glumes are caducous from base of rhachilla; the rhizome

is unknown. From *C. laetus,* C. B. Clarke, it differs in the nut narrowly elliptic and acute, not obovoid, in the compound umbels and fewer-flowered spikelets.

Bulbostylis capillaris, (L.) C. B. Clarke.—Synonym *Fimbristylis capillaris,* (L.) A. Gray.

North of Cooper Creek, coll. J. B. Cleland. First record for South Australia.

Schoenus fluitans, Hook. f., has been found near Encounter Bay by Professor Cleland.

CHENOPODIACEAE.

Bassia uniflora, F. v. M. var. **incongruens,** n. var. Variat praecipue semine fere verticali, foliis 7-15 mm. longis, spinis tenuibus 2-5 mm. longis, perianthii basi cavâ obliquiore.

Flinders Range and the Far North.—This is the form mentioned by Mr. R. H. Anderson in his Revision of the genus *Bassia,* in Proc. Linn. Soc. N.S. Wales, 48; 329 (1923), as having been found at Hergott and on the Arkaringa Creek. It occurs also north of Cooper Creek and seems worthy of at least varietal rank. The vertical seed brings it near *B. parallelicuspis,* R. H. Anderson, but in general appearance it is nearer *B. uniflora.* It differs from *B. parallelicuspis* in the longer and divergent spines, and from *B. uniflora* in the vertical seed and the fruiting perianth less expanded at summit and with a somewhat more oblique base.

AMARANTACEAE.

Trichinium helipteroides, F. v. M. var. **minor,** n. var. Variat parvitate omnium partium, foliis late lanceolatis circiter 1 cm. longis, spicis globosis 8-10 mm. diam. breviter pedunculatis, bracteolis bracteam fere aequantibus, perianthio 5 mm. longo.

Blood Creek (N. of Oodnadatta); coll. S. A. White. Has somewhat the aspect of *Helipterum moschatum.*

RANUNCULACEAE.

Ranunculus parviflorus, L., var. **glabrescens,** n. var. Forma fere glabra, foliorum segmentis petiolulatis lobulatis, petalis interdum 6, achaeniis tuberculatis breviter rostratis.

Reedbeds, near Adelaide; River Murray; Flinders Range.

LEGUMINOSAE.

Swainsona villosa, n. sp. Planta tenuis humilis pilis simplicibus villosa praesertim in partibus junioribus, foliolis 5-7 obovato-cuneatis 1-1½ cm. longis supra glabrescentibus, stipulis lanceolatis, floribus purpureis circiter 5 in racemo pedunculato, bracteis pedicellis fere aequilongis, calyce 6 mm. longo pilis nigris villoso, dentibus acuminatis tubum saltem aequantibus, bracteolis minutis, vexillo circiter 15 mm. lato ecalloso, carinâ obtusâ alis aequilongâ, ovario villoso, stylo usque ad medium barbato, apice recto post stigma penicillato, legumine ignoto.

Glen Ferdinand, Musgrave Range; coll. S. A. White. Differs from the following in the colour of the keel and the small tuft of hairs behind the stigma, not all round it; also in the style straight towards the summit. The other long-haired species are without hair-tufts near the stigma.

Swainsona flavicarinata, n. sp. Planta prostrata griseo-viridis pilis simplicibus villosa, foliolis 5-9 obovato-cuneatis vel oblongo-cuneatis 6-15 mm. longis utrinque pilosis vel supra glabrescentibus, stipulis anguste lanceolatis, racemo 6-12-floro, bracteâ longiore quam pedicellus brevis, calycis 8 mm. longi dentibus lanceolato-subulatis tubo longioribus, bracteolis tubum aequantibus, vexillo rubro circiter 12 mm. lato, ungue incrassato, alis rubris brevioribus quam

carina flava incurva, stylo complanato totâ longitudine barbata, apice fere directi-angulatim inflexo circum stigma penicillato, legumine ovoideo-oblongo compresso villoso 5-14 mm. longo secus suturam impresso.

Near Lake Torrens; along Broken Hill railway; Strzelecki Creek; near Great Bight; western New South Wales; Barrow and Fraser Ranges (Western Australia). Differs from the other long-haired species by the style abruptly bent inwards near the summit, not merely hooked. The yellow keel is always conspicuous.

Swainsona reticulata, n. sp. Planta humilis pilis simplicibus appressis pubescens, foliolis 5-9 oblongo-cuneatis vel oblongo-linearibus obtusis vel emarginatis, stipulis lineari-lanceolatis, racemo 2-6-floro, bracteis pedicello saepius aequilongis, calycis 5-6 mm. longi dentibus saepe acuminatis, bracteolis minutis, vexillo 10-12 mm. lato base parum calloso vel ecalloso, carinâ obtusâ alis aequilongâ, ovario pubescente, stylo totâ longitudine barbato, apice directi-angulatim inflexo sine penicillo, legumine subcylindrato 15-20 mm. longo 3-4 mm. lato nervis eminentibus reticulato pubescente secus suturam profunde impresso biloculato.

Murray lands; Wynbring; Musgrave Range; between Ooldea and Great Bight; Lake Victoria (New South Wales). Near *S. oroboides,* but differs in the cylindrical non-inflated 2-celled pod, the obtuse leaflets and the flowers in a short raceme.

Swainsona campestris, n. sp. Planta rigidula pilis simplicibus appressis pubescens, foliolis 5-11 linearibus vel lineari-lanceolatis acutis 1-2 cm. longis, stipulis longis subulatis, floribus purpureis 4-8 in racemo, bracteâ breviore quam pedicellus, calyce 5 mm. longo nigri-pubescente, dentibus lanceolatis tubo brevioribus, bracteolis minutis, vexillo circiter 10 mm. lato ecalloso, carinâ obtusâ alas subaequante, pedunculis fructiferis elongatis rigidis patentibus, stylo totâ longitudine barbato, apice recto, legumine subcylindrato villoso 12-20 mm. longo circiter 4 mm. lato secus suturam profunde impresso biloculato apicem versus saepe incurvo.

Hughes Railway Station (Nullarbor Plain); coll. E. H. Ising. Differs from the preceding in the straight style, the acute leaflets, the long rigid fruiting peduncles and the less prominently reticulate pod.

Swainsona viridis, n. sp. Planta viridis prostrata fere glabra, foliolis 7-11 obovatis nonnunquam emarginatis vel fere obcordatis 5-10 mm. longis margine et nervo medio pilosulis, stipulis magnis foliaceis obtusis semicordatis, floribus purpureis 5-8 in racemo, bracteis foliaceis ovato-lanceolatis ciliolatis pedicello brevi longioribus, calyce 7 mm. longo glabro absque dentibus lanceolatis ciliolatis tubum aequantibus, vexillo circiter 15 mm. lato ecalloso, carinâ obtusâ alis sublongiore, bracteolis lanceolatis tubo calycis fere aequilongis, ovario pubescente, stylo totâ longitudine barbato apicem versus recto, legumine ignoto.

Curnamona Station (north of Yunta Railway Station); coll. T. G. B. Osborn. A handsome species owing to the bright flowers and green foliage; well distinguished from *S. campylantha* and other species by the broad leafy stipules, bracts and bracteoles.

Swainsona microcalyx, n. sp. Planta gracilis ascendens pilis minutis appressis centraliter affixis puberula, foliolis 3-9 oblongo-cuneatis vel obovato-cuneatis obtusis vel emarginatis supra glabrescentibus 5-12 mm. longis, stipulis lineari-lanceolatis, floribus parvis purpureis 12-20 in racemo rigidule sed graciliter pedunculato, bracteâ pedicello breviore, calyce 3 mm. longo, dentibus 1 mm. longis, bracteolis minutis, vexillo circiter 8 mm. longo latoque ecalloso, alis carinae obtusae aequilongis, stylo tenui totâ longitudine barbato apicem versus recto, legumine non bene maturo subcylindrato apprese puberulo 17 mm. longo 3-4 mm. lato.

Tarcoola; coll. E. H. Ising. This species belongs to the section with forked hairs attached by their centre. It differs from other members of the section in the smaller, more numerous flowers; the long stiff peduncles resemble those of *S. campestris* but are much more slender.

Swainsona stipularis, F. v. M. (1852). This is the valid name of this species, as *S. phacifolia,* F. v. M. (1850) is a *nomen nudum.* The latter name was published, without any description, in a letter to the editor of the *South Australian Register,* signed "Dr. Ferdinand Mueller," and printed in the issue of 19th Feb., 1850. In the course of the letter Mueller wrote:—"To the already known kinds of the beautiful *Swainsonia (sic),* my researches add three new ones, very valuable in horticulture, *S. phacaefolia, S. viciaefolia, S. Behriana.*"

Pultenaea dentata, Labill. Mount Compass. First record for South Australia.

Glycine sericea, (F. v. M.) Benth., var. **orthotricha,** n. var. Variat pilis appressis erectis (non reflexis ut in typo et in ceteris speciebus nostris), seminibus ovoideo-oblongis nonnunquam maculosis.

Alberga River, coll. H. W. Andrew; Central Australia, coll. R. Tate.

Indigofera enneaphylla, L. Cordillo Downs (north of Cooper Creek); coll. J. B. Cleland. First record for South Australia.

Cassia Sturtii, R. Br., var. **planipes,** n. var. Variat foliis 3-jugis ovato-oblongis 12-20 mm. longis, petiolo ad perpendiculum complanato canescente, antherâ infimâ ceteris sublongiore, legumine 5-9 cm. longo 12-19 mm. lato.

Cordillo Downs; coll. J. B. Cleland.

Tephrosia sphaerospora, F. v. M.—Between Cordillo Downs and Cooper Creek; coll. J. B. Cleland. First record for South Australia.

Zygophyllaceae.

Zygophyllum compressum, n. sp. Planta annua erecta, foliolis ovatis vel orbicularibus aut supremis oblongis 8-15 mm. longis, altero foliolo alterum adversum aspectante (non utroque in eodem plano divergente ut in ceteris speciebus), petalis 4 flavis apice rotundatis 4-6 mm. longis duplo longioribus quam sepala, staminibus 8, filamentis alatis et leviter bidentatis, disco in 4 glandulas erectas lineari-oblongas truncatas ovarium subaequantes apice ciliolatas diviso, capsulâ obovoideâ nutante 7-10 mm. longâ basi et apice 4 angulis rotundatis instructâ, seminibus 2-3 in quoque loculo.

Port Augusta to near Fowler Bay; Far North; Central Australia. The small flowers and capsules and the leaflets turned inwards so as to face each other distinguish this species from *Z. glaucescens.*

Zygophyllum tesquorum, n. sp. Planta annua ascendens, foliolis oblique oblanceolatis vel oblongo-ellipticis 6-10 mm. longis integris, petalis 5 in siccitate albis circiter 6 mm. longis duplo longioribus quam sepala, staminibus 10, filamentorum dimidio inferiore dilatato sed non alato, capsulâ globosâ 6-7 mm. longâ 5-angulatâ in pedunculo filiformi patente vel deflexo 7-10 mm. longo, semine haud nitente 1 in quoque loculo.

Lake Torrens; Far North; Central Australia. Near *Z. iodocarpum,* differing in the much longer petals and peduncles and in the dull seeds. This and the preceding species belong to the section *Roepera.*

Tremandraceae.

Tetratheca halmaturina, n. sp. Suffrutex humilis fere glaber, caulibus teretibus rigidis junciformibus glandulis sessilibus conspersis, foliis ad paucas squamas minutas subulatas reductis, flore breviter pedunculato in axillâ bracteae subulatae, petalis rubris vel albidis 9-13 mm. longis, tubo antherino antherae fere

aequilongo, ovario apicem versus puberulo, ovulo 1 in utroque loculo, capsulâ obovato-cuneatâ, seminibus puberulis.

Kangaroo Island. Near *T. juncea,* Sm., but differs in the stems with sessile glands and without acute angles or wings, the sepals and petals 5 instead of 4, the longer anther-tube and the single ovule in each cell. From the Western Australian species it differs in the pubescent seeds.

EUPHORBIACEAE.

Phyllanthus thymoides, Sieb., var. **parviflorus,** n. var. Fruticulus, ramulis pilis minutis patentibus sparse vestitis, foliis obovato-cuneatis apice fere truncatis 3-6 mm. longis glabris absque margine ciliato, sepalis masculis ovatis 1 mm. longis ciliolatis, antheris subsessilibus liberis, filamentis brevissimis liberis et glandulis minutis suffultis.

Near Wolseley; also in the Victorian Tatiara. Varies from the type in the smaller flowers, the shorter filaments always free and the minute glands at their bases.

BORRAGINACEAE.

**Heliotropium supinum,* L. Blanchetown, River Murray; coll. A. Morris.—Mediterranean region. Apparently the first time this weed has been recorded in Australia.

COMPOSITAE.

Pluchea rubelliflora, (F. v. M.) n. comb., is described by Bentham as "glabrous" and by Mueller (Rep. Babb. Exped., 11) as "sometimes glandular-downy and hispid." The latter statement is confirmed by the specimens we have from Cordillo Downs, Strzelecki Creek, and Flinders Range.—*Eyrea rubelliflora,* F. v. M., in Linnaea, 25: 403 (1852); *Pluchea Eyrea,* F. v. M. Rep. Babb. Exped. 12 (1859).

A MONAZITE-BEARING PEGMATITE NEAR NORMANVILLE.

By R. Grenfell Thomas, B.Sc.

[Read October 9, 1924.]

Plates XXIII. and XXIV.

The pegmatite formation described in this paper is situated in Section 219, Hundred of Yankalilla, about 4½ miles south-west of Normanville. The oldest rocks of this area are highly altered sediments which are traversed to a considerable extent by intrusions of syenitic and granodioritic pegmatite, varying in width from a few inches to several feet. The metamorphism which these sediments have undergone has been chiefly of a regional-dynamic type resulting in the production of quartzose schists and mylonised grits in which the original sedimentary structure is, for the most part, easily seen. Thermal contact metamorphism resulting from the pegmatite invasions is also noticeable, especially where the igneous dykes are of large dimensions or are injected on a *lit-par-lit* system. The most obvious result of this thermal metamorphism has been a more or less complete recrystallisation of the schistose grits in immediate proximity to the pegmatite bodies. The rock types formed in this way are very variable, but are often micaceous or sericitic schists; occasionally there is evidence of partial assimilation of the sediments by the igneous rock.

The strike of this complicated series of metamorphic rocks, though subject to small variations, is approximately N. 50° E.,[1] which is roughly parallel to the sea coast in the vicinity. The dip of the beds averages 35° towards S. 40° E. The direction of strike and dip account to some extent for the bold and precipitous cliffs—often almost 300 feet in height—which mark the scarp face of these beds, and which form such a conspicuous feature of the coastal scenery to the south of Normanville.

The age of this series of metamorphic rocks, on a stratigraphical basis, cannot as yet be fixed with any certainty. They have been provisionally classed as "Barossian," the evidence being chiefly based on structural and mineralogical similarities, for as yet the stratigraphical relationship between the Normanville schists and the Adelaide Series has not been finally determined. As will be shown in a later section of this paper, on criteria of radioactive disintegration, the age of the monazite, deduced from the lead-thorium ratio, is so great as to imply at least an early Proterozoic age for the rocks with which it is associated.

Particulars of the Pegmatite.

As previously stated, the pegmatite in which the monazite occurs is situated in Section 219, Hundred of Yankalilla. The formation outcrops in the angle of the cliffs formed by the sea and the "Little Gorge" at a height of almost 200 feet above sea level. It is best exposed on the seaward cliff, where it extends for at least 70 feet with a thickness varying from 2 feet up to about 15 feet. The outcrop on the slope facing the "Little Gorge" is not so well exposed, but can be traced intermittently for a greater distance. The width of the body on this slope is also very variable.

The dip is 40° towards S. 30° E., and the strike is N. 60° E., so that the pegmatite is approximately conformable to the dip and strike of the metamorphic rocks in which it occurs.

(1) All bearings are given with reference to magnetic north.

The main body of the pegmatite is composed of a medium-grained, light-coloured, felspathic rock containing a considerable amount of bluish quartz, and in many instances there is a decided tendency towards a graphic intergrowth of the quartz and felspar.

Microscopical examination reveals the fact that the rock is closely allied to the grano-diorites and their pegmatitic differentiates, orthoclase being almost entirely absent, while the bulk of the felspar is albite. A dusty decomposition of the felspar is very noticeable, even in the freshest material obtainable. Strain structures are very strongly developed in both the quartz and felspar, both of which show a marked shadow extinction, while the twinning lamellae of the felspar are often bent. Evidence of dynamic metamorphism is also afforded by patches of granular quartz and felspar, most of which are clearly derived from the original minerals by crushing. The chief accessory mineral present in the slide is apatite, which is relatively plentiful as minute colourless prisms included in the felspar and less frequently in the quartz. Sphene and rutile grains are occasionally present, while secondary chlorite is sometimes rather common.

The ferro-magnesian component of the magma is represented by a remarkable type of biotite mica, the nature of which will be discussed later. This mica is confined almost exclusively to the borders of the pegmatite, where it forms large sheets up to a foot or more in diameter and of considerable thickness. These sheets are devoid of crystal outline and are generally bent and fractured; they are best developed on the hanging-wall of the formation. On the footwall there is a marked tendency for the mica to pass into a fine-grained black aggregate, and it is in this matrix that the two chief accessory minerals of the pegmatite —rutile and monazite—are typically developed.

The rutile is present in sufficient quantity to constitute an important ore body; its presence has been recognised for a number of years and it has been mined to some extent from time to time. The Deputy Government Geologist (R. Lockhart Jack) reported in 1921 on the possible commercial value of the deposit and briefly described the mode of occurrence of the rutile.[2]

It was then estimated that about 18 tons of hand-picked rutile had been mined. As the existence of the monazite was not suspected, it is certain that a considerable amount of this mineral was present in the rutile disposed of, and would probably have enhanced the value of the ore had its presence been recognised. Mining operations have now been suspended for a number of years, although a fair amount of rutile is still visible in the pegmatite body.

Mode of Occurrence of the Rutile and Monazite.

The habit of the rutile so closely resembles that of the monazite that remarks on the occurrence of one mineral may, for the most part, be satisfactorily applied to the other. It must, however, be borne in mind that the rutile is largely in excess of the monazite, for whereas the rutile is present throughout the greater part of the formation which is exposed, the monazite, so far as could be determined, is confined chiefly to the outcrop on the seaward slope. The two minerals are typically developed as lenses or "augen," which have their longer axes parallel to the direction of schistosity of the country rock. These lenses are, for the most part, surrounded completely by biotite, but occasionally there is a local development of quartz enclosing the mineral; this is more noticeable in the case of the rutile than the monazite.

It may also be mentioned that in some instances the rutile is present as irregular segregations in the felspathic rock itself; the monazite, however, was

(2) The developments which exposed the monazite were made subsequently to Mr. Jack's visit.

not observed to occur in this manner. The lenses of rutile are very variable in size, the largest being almost 2 feet across and 8 inches in diameter, but the bulk of the material is considerably smaller in size. In the case of the monazite, the largest homogeneous specimen collected by the writer measured 6 inches long by 4 inches wide and 3 inches thick, the weight being approximately 4 lbs. Another specimen, apparently not quite homogeneous, weighed $5\frac{1}{2}$ lbs. In proportion to the size of the pegmatite body these specimens are certainly remarkably large.

Although the monazite may not prove to be widely developed throughout the formation the concentration in certain parts is very great. In support of this, it may be remarked that the writer was able to collect on various occasions a total weight of approximately 100 lbs. of the clean mineral.

The monazite and rutile are seldom found associated in one nodule, but when this does occur the boundaries of either mineral are invariably sharply defined and show no definite evidence of the order of consolidation.

Particulars of the Monazite.

When in the matrix the monazite so resembles the rutile that it is only with difficulty that the two can be identified; on a freshly fractured surface, however, the many differences are at once apparent. With the exception of two individual crystals all the monazite collected was of the massive variety, very compact in texture and with no tendency to granular aggregation.

The colour on a freshly broken surface ranges from light reddish-brown through clove-brown to a deep chocolate. With the exception of the chocolate-coloured material, which generally has sharply defined boundaries, the other variations in colour merge imperceptibly. The lustre is distinctly resinous. The mineral is typically opaque in the hand specimen, but occasionally the thinnest edges of the freshest material are sub-translucent.

The specific gravity varies from 4·84 to 4·95 in the fresh mineral, the majority of the specimens corresponding to the highest figure.

The specific gravity falls off rapidly in the altered varieties.

The hardness, though somewhat variable, is approximately 5, and the mineral is somewhat brittle.

Macroscopic inclusions, irrespective of rutile, are chiefly confined to veinlets of quartz and biotite. These veins are rather plentiful and are generally roughly parallel to each other. They represent strain structures formed subsequently to the consolidation of the monazite and filled with residual magmatic products. They are always disposed at right angles to the plane of schistosity of the micaceous matrix, and the quartz filling them is generally somewhat fibrous.

Cleavage is seldom observable in hand specimens, and when it does occur it is but poorly developed. Weathered specimens are devoid of resinous lustre and often have an ochreous texture and colour. The high specific gravity is lost and in the final stages the mineral presents a cellular clayey appearance and is permeated by reddish patches and streaks.

Euhedral Crystals of Monazite.

Monazite showing a definite crystal form is of rare occurrence in the pegmatite, and the writer was able to obtain only two imperfect specimens. These were found embedded in the decomposed micaceous matrix, and are themselves so altered on the crystal faces as to render them useless for goniometric measurements. So far as can be determined they exhibit the tabular monoclinic symmetry characteristic of monazite.

The larger crystal shows at least seven well-defined faces and has the following dimensions:—

Length	..	..	..	4 cms.
Width	..	..	..	2·25 cms.
Thickness	..	..	..	1·25 cms.

The weight is 24·5 grams.

The smaller crystal shows at least 12 faces and weighs 15·5 grams. Its dimensions are:—

Length	..	..	..	2·75 cms.
Width	..	..	..	2 cms.
Thickness	..	..	..	1·5 cms.

Microscopic Features of the Monazite.

Several thin sections of the monazite were prepared for petrological examination, and these reveal features which are not apparent in the hand specimen. In slides of the order of ·03 mm. in thickness the fresh mineral is quite transparent and ranges from colourless to faint yellow, but it is traversed in all directions by an irregular network of brown semi-opaque material which appears to be amorphous. The microscopical structure closely resembles that of a partially serpentinised olivine rock. Most of the brown amorphous material is clearly an alteration product of normal monazite and probably represents the hydrated oxides of the rare earth metals. Its formation, as in the case of olivine changing to serpentine, has been accompanied by an expansion which has produced radially disposed cracks around certain irregular nuclei, and along these cracks the alteration has proceeded.

The unaltered mineral is distinctly homogeneous so far as can be determined from its optical properties, though variations in the thorium content are revealed by other tests and will be discussed later.

Some of the dark patches show very strongly defined edges, a fact which suggests that they may represent residual structures of a crystalline mineral more susceptible to alteration than the normal monazite. There is some evidence in favour of this view which will be discussed in connection with the radioactivity of the mineral.

The refractive index and birefringence of the unaltered mineral are both high. Pleochroism is not noticeable except in thick sections. The mineral is optically continuous over relatively large areas and does not show any marked strain shadows under crossed nicols.

With regard to the veinlets of decomposed brown material it may be noted that these pass without interruption through the quartz and biotite veins included in the mineral, and are thus clearly secondary alteration features.

Analysis of the Monazite.

The material selected for chemical analysis was the freshest obtainable broken from the centres of large specimens and freed from any mechanically mixed quartz and rutile by attracting it to a strong electro-magnet. The method of analysis followed was the usual procedure of decomposing the finely powdered mineral with hot sulphuric acid and subsequent precipitation of the rare earth oxalates from the aqueous extract. Thorium was estimated by precipitation of the hydrated oxide from a neutral nitrate solution by hydrogen peroxide and the result checked by the more usual thiosulphate method.

No attempt was made to separate the individual rare earths of the cerium and yttrium groups, as this cannot be done with quantitative accuracy. The other constituents were determined by the standard methods.

Statement of Analysis.

Phosphorus pentoxide (P_2O_5)	26·88
Cerium oxide (Ce_2O_3)	25·09
Lanthana and Didymia (La_2O_3, Di_2O_3, etc.) ..	24·32
Thorium oxide (ThO_2)	10·70
Yttria and Erbia (Y_2O_3, Er_2O_3, etc.)	4·00
Calcium oxide (CaO)	2·60
Titanium oxide (TiO_2)	1·70
Silica (SiO_2)	1·65
Ferric oxide (Fe_2O_3)	·85
Lead oxide (PbO)	·55
Water at 110° C.	·40
Water and gases above 110° C.	1·52
Total	100·26

Discussion of the Analysis.

As might have been anticipated from the general appearance of the mineral, the analysis reveals a monazite of unusual and interesting composition. The high percentage of thoria is perhaps the most striking point, especially as the monazites hitherto recorded in South Australia have been abnormally poor in this constituent.

The relatively high percentage of calcium and titanium suggests the presence of sphene, but as this mineral has not been observed as inclusions in the monazite its presence cannot be definitely established. In any case the thorium, if combined partly as silicate, in which form it is thought to exist in monazite, would still be unsatisfied by the available silica, and thus preclude the existence of sphene. Moreover, since the calcium and titanium oxides are not in the correct ratio to form the perofskite molecule, they are probably to be taken as essential constituents of this particular monazite.

The rare earths of the yttrium group are well represented, and must also be regarded as forming part of the complex monazite molecule since there are no obvious inclusions of xenotime or other yttrium minerals.

In view of the fact that monazite is normally one of the anhydrous phosphates group, the relatively high percentage of combined water is especially significant as showing the alterations that the mineral has undergone. The change is probably to be interpreted as a partial hydration of the rare earth bases with simultaneous leaching of phosphoric acid; this argument is supported by the microscopic structure of the mineral when examined in thin sections.

Uranium is either absent or exists in such minute amount as to be impossible of detection by the usual analytical methods. If it is entirely absent the lead must be regarded solely as a degradation product of the thorium series.

Niobium and tantalum were especially tested for, since the presence of minerals of the fergusonite or samarskite groups might reasonably be suspected in a pegmatite formation so rich in titanium and rare earths; both, however, were absent. Aluminium was also proved to be absent.

Age of the Monazite from the Lead-Thorium Ratio.

Although the material analysed was not absolutely free from alteration, it was considered desirable to establish the approximate age of the mineral from the ratio of the lead to the thorium.

The following formula, for which the writer is indebted to Prof. L. Cotton, of Sydney University, was used:—

$$\text{Age} = \frac{\text{Pb.}}{\text{Th.} + \cdot 56 \text{ Pb.}} \times 2065 \times 10^7 \text{ years.}$$

Pb. represents the percentage of metallic lead and Th. the percentage of metallic thorium, as found by chemical analysis.

The analysis gave: $\cdot 55\%$ PbO $= \cdot 51\%$ Pb.
$10 \cdot 70\%$ $ThO_2 = 9 \cdot 40\%$ Th.

Therefore we have:

$$\frac{\cdot 51}{9 \cdot 40 + (\cdot 56 \times \cdot 51)} \times 2065 \times 10^7 \text{ years.}$$

i.e., 1,073 million years (approx.).

From the extreme age of the mineral, and consequently of the rocks with which it is associated, it is evident that the formation must be regarded as of, at least, Lower Proterozoic age.

Radioactivity of the Monazite.

The high thorium content of the monazite is responsible for a marked radio-activity of the mineral which may be demonstrated by its effect on a photographic plate or a sensitive ionisation electroscope. A well-defined scintillation is also obtained when the mineral is exposed to the fluorescent screen of a scintilloscope.

When a polished face of the mineral is placed on a photographic plate wrapped in opaque paper, and left undisturbed in a light-tight box for several days, the plate, on development, shows a strongly defined impression of the mineral. The impression is, however, not of uniform intensity and shows irregular patches of higher activity distributed through the normally active material. These patches of superior activity were found to correspond in general, to the darker portions of the mineral, and especially to the chocolate-coloured variety. It thus becomes evident that the thorium is not uniformly distributed throughout the mineral, although petrological examination reveals no appreciable difference in the optical properties of the light and dark coloured varieties. In this connection it should be noted that those portions of the mineral which macroscopically appear dark are seldom dark coloured in thin section, and are in general quite distinct from the semi-opaque brown decomposition material which is such a typical feature of the mineral as seen under the microscope.

In one specimen the dark coloured and highly active material was observed to be enclosed by well-defined boundaries which appeared to have originally been crystal faces (see pl. xxiii., fig. 2), but usually the distribution is quite irregular.

The rate of discharge of a sensitive ionisation electroscope by the mineral was found to be about two and a half times as great as that produced by an equal amount of Brazilian monazite sand known to contain approximately 4 per cent. of thoria. This test, therefore, roughly confirms the percentage of thoria obtained by analysis.

The insoluble residues, consisting principally of silica and lead oxide, obtained in the course of a bulk analysis of the ore, still showed a marked radio-activity, notwithstanding the fact that they contained no thoria or unaltered ore. This fact must be attributed to the presence of a small amount of the highly active substance, mesothorium, which would naturally tend to concentrate in the insoluble residues.

The Rutile.

The macroscopic structure of the rutile is typically massive, and in no instance does it show any tendency to form distinct crystals. In many cases it is not so compact as the monazite, but this feature is largely due to the shattering effect of dynamic metamorphism. The cleavage, when shown, is much interrupted and the fracture is very rough. The colour varies from a typical dark red to almost black and the lustre is occasionally sub-metallic.

An iridescent tarnish is very common, but this alteration is purely superficial and weathering in the normal sense is entirely absent. The mineral is quite opaque in the hand specimen. Macroscopic inclusions are chiefly confined to quartz, but are not common.

Microscopic Structure.

The microscopic structure is somewhat complicated owing to the presence of two types of twinning, one normal, the other in part polysynthetic. The cleavage is also well shown. The colour varies from reddish-brown to yellow, partly according to the thickness of the slice and partly on account of well-defined areas of variable composition. Ilmenite is a rather common inclusion, especially in the dark-coloured varieties, where it often forms small veins traversing the mineral. It also occurs as a dusty aggregate following the cleavage cracks, and in this form appears to be secondary.

The refractive index and birefringence are both characteristically high, while the pleochroism is not strongly marked. Optical continuity over large areas is a common feature.

Composition of the Rutile.

Several partial analyses of the rutile were made, primarily to determine if it contained any rare earths or other abnormal constituents. The analyses, however, revealed a variation from 95 to 98 per cent. of titanium dioxide, the remainder being chiefly iron with a little silica and a strong trace of vanadium.

The presence of vanadium is noteworthy, although the wide distribution of traces of this element in ilmenite, rutile, and other titaniferous minerals is now recognised. As might be expected, the darker varieties of the rutile contain the most iron; they are also richer in vanadium than the lighter-coloured types. No trace of radioactivity could be detected in any of the varieties.

The Biotite Mica.

The biotite mica associated with the pegmatite is, on account of its microscopic structure, one of the most remarkable types yet recorded from South Australia.

Its mode of occurrence has already been referred to in the general description of the pegmatite. In macroscopic appearance the mica is a greenish-bronze colour and occasionally shows a reddish tinge; the lustre is nacreous. It is quite opaque in the hand specimen.

The basal cleavage is perfect, as usual, and the laminae so obtained are flexible but quite inelastic. The "books" are generally considerably bent and cross fractured and lack a definite crystal outline.

In weathering, the mica first tends to lose its dark colour and becomes "greasy" to the touch. In the final stages it passes to a fine-grained flaky aggregate closely resembling talc. There is a considerable development of this talcose material in certain parts of the formation.

Microscopic Features.

When microscopically examined in very thin sections cut parallel to the basal plane, the mica shows a most extraordinary development of rutile inclusions. These are arranged in the form of a continuous sagenite web which exhibits a very remarkable degree of symmetry and regularity. The individual needles are exceedingly thin but attain considerable length. They intersect chiefly at angles of 60° or 120°, and are so abundant that sections of the mica of the usual order of thickness of rock slides are opaque. For this reason it was often found impracticable to prepare sections by the usual process of grinding, apart from the fact that abrasion tends to destroy the symmetry of the web-like inclusions. Accordingly, most of the sections examined were prepared from the thinnest possible flakes that could be obtained by cleaving the mineral in a direction parallel to the basal plane.

Under low power magnification the needles appear dark and opaque, but this is chiefly due to the high refractive index of the rutile, for under the high power they are seen to be clear and almost colourless, and show straight extinction with crossed nicols.

A large number of sections of the mica were examined, and in each case the perfect sagenite web was found to be developed to the same extent. In no instance does the web of inclusions become sufficiently coarse to be visible to the naked eye; in fact, its consistent uniformity is a characteristic feature. The only exception is that occasionally minute six-rayed clusters of rutile, resembling pressure or percussion figures, are to be seen in some of the microscope sections; these, however, are absent in the majority of the material.

The optical properties of the mica itself are difficult to determine on account of the persistence of the web. In colour it varies from light brown to a faint smoky-grey, according to the thickness of the section. Sections parallel to the basal plane are isotropic, but no interference figure can be obtained in convergent polarised light owing to the disturbing effect of the inclusions; accordingly the axial angle could not be obtained. The refractive index is very close to that of the balsam.

Sections of the mica cut at right angles to the basal plane show the intense absorption characteristic of most biotites. It is also noteworthy that the inclusion web is not visible in such sections, so that evidently it is confined to the plane of the basal cleavage.

It was found impossible to obtain either pressure or percussion figures on the mica, probably owing to the presence of the web. Transmitted light does not produce asterism so far as can be seen from the microscope slides.

It is peculiar that the mica shows no evidence of the pleochroic haloes commonly developed in biotites since the radioactivity in the adjacent monazite would seem to provide the necessary conditions for these interesting structures.

Chemical Analysis of the Mica.

A chemical analysis of the mica was carried out primarily to determine whether it was a biotite or a phlogopite, as the general appearance rather suggested the latter mineral; the analysis, however, revealed a biotite.

Considerable difficulty was experienced in accurately determining the amount of included rutile as distinct from any combined titanium. This difficulty arose on account of the extremely fine state of division of the included rutile, as there was a marked tendency for this rutile to be partly dissolved by the weak mixture of sulphuric and hydrofluoric acids used in decomposing the mineral. The difficulty was eventually overcome by using only sufficient sulphuric acid to ensure

that no titanium was volatilised as fluoride, and relying mainly on the hydrofluoric acid to decompose the mineral, and leave the included rutile unaffected.

The estimations of titanium were done by the colourimetric method, and in the case of the determination of the total titanium the result was checked by the gravimetric method after precipitation by the basic acetate method. Since the results obtained represented the composition of the mica together with the included rutile, it was necessary to recalculate the analysis, making allowance for the amount of inclusions, in order to arrive at the composition of the mica itself.

Statement of Analysis.

	A.	B.
Silica, SiO	37·10	39·69
Alumina, Al_2O_3	13·60	14·55
Ferric Oxide, Fe_2O_3	4·47	4·78
Ferrous Oxide, FeO	7·63	8·16
Titanium Dioxide, TiO_2 ..	7·00†	·27‡
Magnesium Oxide, MgO ..	16·60	17·76
Calcium Oxide, CaO	1·00	1·07
Soda, Na_2O	1·78	1·91
Potash, K_2O	8·91	9·53
Hygroscopic Water	·40	·43
Constitutional Water, etc. ..	2·77	2·96
Total	101·26	101·11

Column A gives results for the mica together with rutile inclusions.
Column B gives recalculated results for the mica itself after eliminating rutile inclusions.
†Total titanium, *i.e.*, 6·75% included rutile and ·25% of constitutional titanium.
‡This figure for constitutional titanium is probably slightly low.
The multiplying factor for recalculating the analysis to rutile-free mica is 1·07 (approx.).

Note on Sagenitic Biotites.

The sporadic occurrence of sagenite webs in biotite and phlogopite micas is, of course, a well-established fact, and according to Iddings it is often a preliminary stage in the decomposition of a titaniferous mica.

In the case of the Normanville biotite, however, there can be no doubt that the structure is primary, or that the sagenite web is syngenetic with the mica, for the structure is developed to the same extent in the fresh mineral as it is in the partially altered varieties.

A somewhat similar mica, from Radium Hill, near Olary, has been described by E. R. Stanley.[3] The writer examined specimens of this material under the microscope and found the sagenite web to be very poorly developed as compared with that in the Normanville mica, nor does the web show regularity and continuity to the same degree.

Other Minerals present in the Pegmatite.

In addition to the minerals already described there is a limited amount of black tourmaline developed in the pegmatite. It generally occurs in graphic intergrowth with quartz. In microscope sections the tourmaline shows no abnormal features except that the colour is somewhat light for schorl, ranging, as it does, from a very pale blue to light brown.

(3) Trans. Roy. Soc. S. Austr., vol. xl., p. 268.

Pyrite was observed in one instance only, forming small euhedral crystals partly embedded in a decomposed micaceous matrix.

Magmatic Relations of the Pegmatite.

Several of the sedimentary and igneous rocks which occur in the vicinity of the "Little Gorge" have been petrologically examined by W. N. Benson,(4) who has pointed out their close mineralogical resemblance to the rocks of the Houghton magma, which are characterised by their high titanium content and, to a less degree, by the abundance of soda.

There can be little doubt that the pegmatite formation described in this paper is also genetically related to the Houghton magma. Typical exposures of this rock occur on the sea cliffs about one and a half miles north-east of the "Little Gorge," and are there associated with other varieties of pegmatite consisting of massive felspar containing coarse segregations of muscovite, ilmenite, black tourmaline, and quartz. Pegmatite of this nature can be seen to merge into the normal Houghton "diorite," from which it is evidently derived.

Less frequently, in the vicinity of the "Little Gorge," there is a development of a variety of pegmatite closely allied to Benson's "yatalite,"(5) and consisting essentially of secondary epidote and actinolite, probably after diopside, together with idiomorphic sphene and a little ilmenite.

About three-quarters of a mile south-west of the "Little Gorge," on the coast, there is an interesting quartz-ilmenite pegmatite developed in the sea cliff. The segregations of ilmenite, many of which are as large as a man's head, are plentifully distributed over the beach in the vicinity.

The great variety of rock types derived from the Houghton magma has been commented on by Benson,(6) but there are several features in connection with the pegmatite described in this paper that are worthy of special notice. In the first place, there is practically no ilmenite developed, but the high titanium content is maintained by the presence of abundant magmatic rutile.

Secondly, there is no development of diopside, actinolite, or other minerals of the pyroxene or amphibole groups, the ferro-magnesium component being represented solely by the sagenitic biotite.

Finally, there is a rich, though apparently limited, development of rare earths in the form of monazite, an accessory mineral which has hitherto been unrecorded from the various pegmatites genetically connected with the Houghton magma.

Acknowledgment.

The analytical work in connection with this paper was carried out in the Geological Laboratory of the Adelaide University, and the writer is much indebted to Prof. Sir Douglas Mawson, not only for facilities granted, but also for the interest which he has shown in the work, and for many helpful suggestions. The writer also wishes to thank Dr. W. T. Cooke for his assistance in solving several problems in connection with the chemical analyses.

(4) Trans. Roy. Soc. S. Austr., vol. xxxiii., p. 101.

(5) *Loc. cit.*, pp. 104, 125.

(6) *Loc. cit.*, p. 137.

DESCRIPTION OF PLATES XXIII. AND XXIV.

Plate XXIII.

Fig. 1.

General view of the pegmatite formation looking south from the Little Gorge. The foreground is an alluvial talus platform about 20 feet above sea level and is intersected by the Gorge Creek.

Fig. 2.

Polished face of monazite photographed by its own radiations, illustrating the irregular distribution of the radioactivity. Natural size. Exposure 14 days.

Plate XXIV.

Fig. 1.

Photo-micrograph of the massive monazite showing quartz veins traversing the mineral. The dark patches represent the amorphous alteration products forming along cracks. ×35.

Fig. 2.

Photo-micrograph of the sagenitic biotite mica in section parallel to the basal plane. Showing symmetrical arrangement of included rutile needles, in thinnest possible cleavage flake. ×35.

THE RELATION OF CLIMATE TO THE SPREAD OF PRICKLY PEAR.

By Professor T. Harvey Johnston, University, Adelaide.

[Read October 9, 1924.]

Plate XXV.

In an address on the Australian prickly pear problem (Johnston, 1923) it was pointed out that the infested pear region commenced at about 22° S. and extended to 33° S., the greatest mass lying between 23° or 24° S. and 31° S.—roughly, between the latitudes of Rockhampton and Newcastle—with its greatest width between 26° and 27° S. The densest infestation lay chiefly between 25° and 30° S. and 149° to 151° E. (150° W. in the article is a misprint for 151° E.), though in southern Queensland very heavy infestation occurred between 151° and 152° E. It was indicated that the invaded area was largely included between the 20 and 30 inch isohyets, though considerable extensions occurred into the region between the 30 and 40 inch and between the 15 and 20 inch isohyets, active invasion proceeding especially between the latter two. It was also pointed out that the pear region had a marked summer rainfall with an annual average of from 20 to 35 inches.

The present paper is largely an amplification of that statement, together with an examination of data available regarding other prickly pear regions of the world.

In the article referred to, the invaded area in Eastern Australia was set down as being in the neighbourhood of 40 to 45 million acres, about five million being in New South Wales. Since that was written, a Royal Commission was appointed in 1923 to inquire into the administration of prickly pear land in Queensland, its report, based on official records, setting down the area in that State as 24,179,707 acres (including 10,419,655 acres of dense pear), this diminished figure being due probably to a more careful assessment of the actual infestation of the invaded area, though the rate of annual increase (837,328 acres) was shown to be practically the same as that which I mentioned, *viz.*, 1,000,000 acres per year. The total area in eastern Australia is, then, at least 30,000,000 acres.

In view of this alarming extension now in progress, one naturally asks in which direction and how far is this invasion likely to proceed. The present paper is an attempt to answer the query by a comparative study of the chief prickly pear regions from the point of view of control by climate, chiefly rainfall. Though other factors, such as altitude, occurrence of frost, range of temperature, nature of soil, and especially the amount of evaporation which takes place, must play an important part, some of them have received only passing attention in the present paper.

Remarks on the Prickly Pears Naturalised in Australia.

As has already been pointed out by Maiden, Johnston, and Tryon, there are many species of prickly pear, nearly all belonging to the genus *Opuntia*, already naturalised in Australia, by far the most important being *O. inermis*, the next in importance being the "spiny pest pear."

The Pest Pear.—The correct name of the common pest pear of eastern Australia is still in doubt. It is generally spoken of in the Commonwealth as *O. inermis*, De C., though Maiden, in 1898 used the name *O. stricta* in preference,

but later adopted with some reserve the former name. Britton and Rose, in their Monograph (1916), regard it as *O. stricta*, Haw.

It was first described and figured by De Candolle, in 1799, as *Cactus opuntia inermis*, and referred to again by him, in 1828, as *O. inermis*. Unless it be decided that the original name is a multinominal, and therefore invalid, De Candolle's name must be regarded as having priority over *stricta* or any other name subsequently given to the species to which our Australian pest belongs. Haworth, in 1803, gave the name *Cactus strictus*, changing it to *O. stricta* in 1812, quoting De Candolle's name and illustrations at the same time. Maiden (1912, pp. 714, 716) stated that it was either a form of De Candolle's species (*O. inermis*, De C., var.), or perhaps a new species closely allied to it. He contrasted specimens from the Sydney Botanic Garden with De Candolle's figure and with *O. airampo*, Phil., mentioning that there seemed to be two forms in Australia—the common pest pear, such as occurs at Scone, New South Wales, and a more erect *airampo* form in the neighbourhood of Rockhampton; but in a later article (1913) he determined the latter as *O. dillenii*. It seems to me that De Candolle's figure agrees sufficiently with the Australian pest pear to allow one to identify the latter as *O. inermis*, consideration being given to probable slight differences in growth as a result of different climatic conditions in France and Australia.

It was suggested in 1914 (Johnston and Tryon, 1914, pp. 62, 112) that *O. bentonii*, Griffiths (1912), was either a synonym of, or was very closely related to, *O. inermis*, while Small (1919, p. 33) placed it as a possible synonym, and Britton and Rose (1919, p. 161) definitely listed it as such, though they retained Haworth's name *O. stricta* for the species. Dr. Britton informed us our pest pear was to be met with on Florida Keys (J. and T., 1914, p. 62, fig. 25), but he subsequently concluded that the species occurring commonly there was distinct, describing it as *O. keyensis* (Britton, in Small, 1919, p. 31, pl. 225; Britton and Rose, 1919, p. 222, fig. 297). During my last visit to Miami, southern Florida (September, 1920), I examined plants of *O. bentonii* and *O. keyensis*, and came to the conclusion that our *O. inermis* did not quite agree with either, though individual specimens of the first-named (originally from Apalachicola, northern Florida) were much more like the Australian plant than the others were. I think it likely that the differences from *O. inermis* exhibited by Dr. Griffiths' plant are not specific but are due to environment. *O. keyensis* is evidently closely related but distinct. The coloured figure of a flowering segment of *O. stricta*, published by Britton and Rose (1919, p. 27, fig. 4), is not quite like that usually seen in Australia, as a comparison with the coloured figure published by Maiden (1912) and with the photograph published by Johnston and Tryon (1914, fig. 3) will show, but the conditions under which the respective plants were grown would no doubt account for the difference. The latter authors have also published photographs showing the habit of the plant (figs. 1-4).

The distribution of the species in America is given as western Cuba; Florida to eastern Texas. It has been suggested (Small, 1919, p. 34) that it is probably a native of Cuba, and has been introduced into United States, America. Even in western Cuba, in the locality quoted by Britton and Rose, the few plants met with there by us in 1913 suggested that they were probably garden escapees [1] (J. and T., 1914, p. 99). Tussac quoted Hayti as the home of the species, and this may well be correct; unfortunately, circumstances prevented us from entering that Republic, though a portion of San Domingo was examined. *O. inermis* occupies almost the whole of the Australian prickly pear region excepting in one part of Queensland.

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(1) A description of the species based on plants growing in the vicinity of Pinar del Rio, Western Cuba, was also published (J. and T., p. 100).

The Spiny Pest Pear.—This species, which has not been satisfactorily identified, occupies a considerable portion of Queensland, *viz.*, between Rockhampton and Gogango and southward to the valley of the Burnett and Mary Rivers. In this region *O. inermis* occurs sparingly and is sometimes spoken of as the "cabbage pear" on account of its colouration, which is distinct from the spiny pest pear. For a long time the latter was not recognised as a distinct form, though Maiden (1912) noticed certain differences in habit between the cactus growing in the Rockhampton district and that growing at Scone, New South Wales. We pointed out to Mr. Maiden, late in 1912, a number of differences between the two, and in 1913 he identified it as *O. dillenii*, a determination with which we disagreed (J. and T., 1914, pp. 7, 112). Britton and Rose (1919, p. 163) erroneously reported *O. dillenii* as a pest pear in Australia, evidently accepting the correctness of Maiden's determination regarding the spiny pest pear, but *O. dillenii*, fortunately for us, is a very uncommon plant in Australia.

I have used the names Spiny Pest Pear, Burnett Pear, Gayndah Pear (1922), and, lately, *O. stricta (O. airampo* [2]*)*, Haworth's name being given because a specimen under that name given me whilst at Kew Botanic Gardens, when grown in Brisbane beside segments of the spiny species from the Burnett River, produced specifically identical plants. The spininess disappeared and the areoles became less pronounced in all new growth on the Burnett specimens, due to the effect of the greater moisture of the Brisbane district, so that the typical growth of *O. stricta* as known at Kew took place. It is quite probable that Haworth confused two quite distinct species, both of them with segments comparatively or practically free from prominent spines (apart from the glochidia) when grown in gardens or in greenhouses. The term "stricta" would apply much better to the Burnett pear than to *inermis*, but as Haworth admittedly renamed De Candolle's species, his name cannot apply to any other.

I have not been able to identify it from the monographs of Schumann and of Britton and Rose. The same species has run wild in many parts of the Punjab, especially between the Jhelum and Sutlej Rivers. It was shortly described by Parker, in 1912, who thought it was *O. ficus-indica;* but I was struck with its resemblance to the spiny pest pear of the Rockhampton district of Queensland and identified this "Punjab pear" as *O. stricta* or a closely related species (J. and T., 1914, p. 10, fig. 65).

It appears, then, that this very important Australian pest pear requires to be properly identified. It is with a reluctance of several years' standing that I have decided to name it as a new species, but would suggest as a tribute to the fine work of Mr. J. H. Maiden, who has devoted so much attention to the Australian prickly pears, that the name *Opuntia Maideni* be given to the spiny pest pear of east-central Queensland—synonyms, *O stricta,* Johnston, 1923, nec Britton and Rose, 1919; *O. dillenii,* Maiden, 1913, in part, p. 1075, figs. 2, 3.

The general appearance of the plant, its flowers and fruits, are indicated in photographs already published by us (J. and T., 1914, figs. 5, 6, 7), and which readily indicate the differences from *O. inermis* in size and form of the segments and fruit, as well as in the number and size of the groups of rather long spines borne by each areole. It may belong to the group Dillenianae, and in Britton and Rose's Key (p. 159) would, if grown under natural conditions without superabundance of moisture, perhaps come next to *O. dillenii* on account of the presence of a variable, though small, number of long acicular spines. It is, however, in my opinion, more closely related to members of the section Tunae, especially

[2] After having inspected Phillippi's original plant of *O. airampo* growing at Santiago, Chile, I was led to conclude that it was different from either of the common Australian pest pears (J. and T., 1914, p. 47, footnote).

to the species *O. antillana* and *O. triacantha*, as diagnosed by those authors. The form and arrangement of the segments and spines are very suggestive of *O. antillana* as described and figured by them (1919, p. 115, fig. 144). The latter species is widely distributed in the West Indies, especially on the smaller northern islands.

The new species, *O. Maideni*, may be briefly diagnosed as follows:—Growing in dense clumps, from 3 to 6 or more feet in diameter, almost erect habit, often with short rounded or somewhat flattened stem; height varying according to amount of shade, usually 3 or 4 feet, but reaching 6 or 8 feet in some situations; segments dull greyish or yellowish-green, fairly uniform in size, usually about 150 mm. (140-200) long by 65 to 75 mm. broad, considerably narrowed at the base; segments readily detached; leaves elongate conical, 2 mm. to 3 mm. long; areoles prominent, 30 mm. to 42 mm. apart on mature segments, practically spineless and not so prominent when grown under moist conditions, but bearing a variable number of unequal spines (1 to 5, generally three or four) 20 mm. to 50 mm. in length, straight, rather acicular, yellowish to greyish; glochidi numerous; small, yellowish flowers with broad obtuse yellow petals, but sometimes a dull smoky-yellow deepening to a dull orange or brownish-yellow toward the base of the petals, and there may be a pinkish tinge at the central part of the outside of the petals; flower bud about 45 mm. to 50 mm. long; fruit reddish-purple to purple, with cavity of calyx practically obliterated when ripe, so that the mature fruit becomes almost rounded except at the extremities, one end being nearly flat and the stalk portion narrowed, total length 40 mm. to 50 mm. (1·7 to 2 inches), diameter 38 mm. to 42 mm. (1·5 to 1·7 inches). Figured by Johnston and Tryon (1914, figs. 5, 6, 7). It flowers in Queensland in late October and November. Its original habitat is probably the Carribean coast.

O. vulgaris, Mill. (*O. monacantha*, Haw.).—This species is very widely distributed in Australia, but is usually now met with sparingly. Previously it occurred as a pest pear in parts of northern Queensland, but has been completely controlled by one of the wild cochineal insects, *Dactylopius indicus*, Green, introduced from India and Ceylon by Johnston and Tryon. It occurs in more or less coastal localities in other States, *e.g.*, Sydney, Melbourne, Perth, Adelaide, and in various places southward towards Port Elliot and Yankalilla. Maiden (1908, pp. 270, 271) has referred to its presence between Port Lincoln, North Shields, and Dutton Bay. Except in the coastal belt in Queensland it has not shown any tendency to spread. Its original home is the warm, moist region of Paraguay, Uruguay, and the adjacent part of Argentina and the Brazilian coast.

O. megacantha, S. D.—A large-jointed, white-spined Mexican species, occurs commonly in the district between Rockhampton and Westwood (Central Queensland), but is restricted to it. At Scone, New South Wales, there is a large clump forming a hedge, but there has not been any invasion of the surrounding district. The species is common and much cultivated in Central Mexico. I have seen it growing commonly as a naturalised alien in a part of Oahu (Hawaiian Islands). Its method of growth and the character of the segments are such that the plant is not likely to be readily disseminated except by birds or deliberately by man.

O. aurantiaca, Gillies, is a much more serious potential pest pear which has gained a strong footing in some localities in the southern Darling Downs, as well as in scattered portions of New South Wales. Its long barbed spines and extremely brittle segments allow of its ready transportation by animals and by water, while its inconspicuous appearance may permit it to become fairly common in a locality without being obvious like the other kinds of prickly pear naturalised in the Commonwealth. Its home is in Uurguay and part of Argentina, and it became naturalised in several localities in southern Cape Colony.

Among the less important species now growing wild in Australia are to be mentioned *O. dillenii,* Haw., occurring as isolated plants in a few southern Queensland localities,(3) its home being the coasts of South Carolina, Florida, eastern Mexico, West Indies, and north of South America; *O. robusta,* Wendl., a central Mexican species with large grey orbicular spiny segments, occurring evidently as a garden escape in a few localities in the foothills of Adelaide (Burnside and Glen Osmond), and not previously recorded as growing wild in Australia; *O. microdasys,* Lehm., a low-growing central Mexican species rather common in parts of the Pilliga district, New South Wales; *O. elatior,* Mill., from northern South America (Panama to Venezuela), occurring at Liverpool, Windsor, and Gungal (Upper Goulburn-Hunter valley) in New South Wales, and very sparingly in a few localities in southern Queensland; *O. tomentosa,* S. D., a southern Mexican "tree pear" prevalent in certain localities in southern and central Queensland, but whose habit is such that the species is not likely to become a very serious pest in Australia; *O. (Cylindropuntia) imbricata,* Haw., from the highlands of Mexico and adjacent parts of the United States, America, is known to occur in a few scattered localities in New South Wales and one in Queensland; members of the *ficus-indica* and *streptacantha* group occur sparingly as garden escapes; *Nopalea dejecta,* S.D., and *N. cochenillifer,* Linn., are met with occasionally in parts of central Queensland, but are of very little importance.

Of the species just referred to, two are very important as probable pest pears if given an opportunity in Australia, *viz.,* *O. dillenii* and *O. elatior.* The former is already a widely distributed plant in maritime situations around the Mediterranean, Canary Islands, and Java, and especially in northern Ceylon and in India, where it constitutes a pest. In the latter country it is extremely widespread, occurring commonly in the Punjab, United Provinces, Rajputana, central India, Mysore, the drier portions of the Presidencies of Bombay and Madras, and is the common cactus of southern India. Its extreme hardiness and its adaptability to withstand maritime conditions are referred to by Small (1919, p. 33) and Burkill (1911). *O. elatior* is also a widely distributed plant in India, occurring especially in the drier central regions from the Punjab and United Provinces to the Deccan, northern Madras, and western part of the Bombay Presidency and extending eastward to the coast in certain localities, *e.g.,* Orissa and northern Madras.

Prickly pears related to *O. megacantha* and the *streptacantha* group, referred to above, now occur widely in the Mediterranean region of Europe, Asia, and Africa, but they have been widely disseminated by man on account of the edible fruit which these species *(O. amyclea* and *O. ficus-indica)* produce, so that they are to be regarded as more or less cultivated, though they commonly grow wild, too. In South Africa the prickly pear menace is caused by a closely related species, the "doornblad" of the Dutch farmer, which has never been satisfactorily identified, though it, like the two just mentioned, belongs to the *streptacantha* group of species, the home of which is on the central Mexican tableland.

Climatic Conditions in the Australian Prickly Pear Regions.

Rainfall.—In the accompanying table there is set out the recorded average annual and monthly rainfall (Hunt, 1914, 1916) of a number of places representative of (1) the invaded area in New South Wales; (2) the adjacent

(3) Maiden recorded it from Dutton Day (Port Lincoln), South Australia, but as he had previously reported *O. monacantha,* from the same district (1903), and did not mention it when dealing with that species later (1913), it is suggested that the name *O. dillenii,* in connection with the South Australian locality, may have been a *lapsus calami.* *O. dillenii,* from Victorian localities (Mueller), is regarded by Maiden, Ewart, and Tovey as referring to *O. monacantha.*

uninvaded region to the east, south and west of (1); (3) the infested region in Queensland; and (4) the adjacent uninvaded area to the north and west of (3).

Murrurundi is close to the northern extremity of the Hunter prickly pear area; Denman (23·12 inches average annual rainfall) marks part of its southern boundary; while its eastern limit lies between Singleton (29·48) and Maitland (34·10). Moree (23·46), on the edge of the open plains; Mungindi (20·47) and Boggabilla (24·01) on the N.S. Wales-Queensland border; Warialda (28·26) and Collarenebri (18·90) are localities in the northern area in New South Wales.

RECORDED AVERAGE ANNUAL AND MONTHLY RAINFALL (IN POINTS).

	Annual Average Rainfall.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1. Scone	2367	255	266	225	155	164	170	163	191	172	177	182	247
Murrurundi	3138	297	293	265	217	221	307	232	261	237	251	257	300
Moree	2346	287	302	284	137	157	188	128	139	148	190	194	192
Mungindi	2047	262	285	265	137	134	169	101	115	117	141	136	185
Warialda	2826	358	331	316	164	188	221	158	184	196	224	223	263
Tamworth	2765	263	274	238	198	193	229	174	196	222	234	269	275
Narrabri	2588	294	296	278	169	207	225	170	170	167	183	219	210
Gilgandra	2435	252	215	222	225	190	207	183	201	152	176	179	233
2. Inverell	3031	373	296	321	191	205	226	190	194	212	264	252	307
Armidale	3194	367	349	296	200	171	269	201	189	218	273	325	336
Maitland	3410	340	348	407	280	265	255	291	232	255	222	232	283
Sydney	4850	364	444	506	547	515	511	478	315	286	319	284	277
Mudgee	2531	216	237	189	180	200	252	182	194	223	224	186	247
Dubbo	2226	209	186	187	182	189	186	160	180	185	166	188	208
Trangie	1713	150	111	200	178	103	131	159	168	132	132	121	128
Nyngan	1721	204	212	179	149	136	124	109	146	096	091	118	157
Coonamble	1976	205	228	199	161	157	149	117	149	140	158	151	162
Brewarrina	1590	218	174	173	119	105	160	091	099	125	106	121	099
3. Clermont	2757	505	458	357	178	151	172	108	069	103	135	191	330
Nebo	3196	667	511	500	208	143	177	132	073	120	088	205	372
Rockhampton ..	4009	789	813	520	234	179	239	170	084	140	173	232	436
Westwood	3071	532	493	316	187	160	221	140	111	133	171	226	381
Banana	2807	425	366	326	129	151	185	144	107	151	219	247	357
Gayndah	3061	466	429	333	131	165	184	155	131	153	246	284	384
Toowoomba	3570	517	463	422	249	232	229	207	191	226	272	328	414
Warwick	2878	369	337	283	173	158	178	180	165	193	246	254	342
Inglewood	2787	365	313	301	135	202	199	185	142	185	229	252	279
Goondiwindi	2557	323	282	308	170	176	177	181	137	166	195	195	247
St. George	2151	314	269	250	159	160	155	131	107	120	152	155	179
Blackall	2163	314	359	270	160	190	120	111	057	074	140	133	235
Charleville	2019	235	295	277	159	160	128	119	073	068	138	155	212
Roma	2485	357	316	313	129	162	166	151	100	161	184	212	234
Yuleba	2711	406	336	346	132	167	189	180	118	140	192	270	235
Brisbane	4685	663	660	616	368	298	265	233	231	206	275	362	508
Dirranbandi	1942	275	229	249	142	131	147	101	094	123	142	121	188
Bollon	1853	246	210	231	129	115	139	102	101	103	148	143	186
4. Ravenswood	2869	755	519	479	141	095	133	049	046	091	111	163	287
Charters Towers ..	2552	572	427	379	173	083	150	058	041	090	076	166	337
Hughenden	1966	482	349	246	136	060	093	045	032	043	077	128	275
Winton	1528	312	290	221	078	061	076	065	027	048	050	123	177
Longreach	1716	198	411	261	084	126	090	082	025	056	108	102	173
Isisford	1920	294	320	291	170	137	120	081	068	064	084	115	176
Alpha	2330	409	386	298	176	129	178	100	072	077	134	157	214

Pilliga (20·46) and Narrabri (25·88) are in the zone to the south of it, Tamworth (27·65) lying near its eastern extremity. The south-western part of the infested region contains Collie (18·25), Gulargambone (24·28), and Gilgandra (24·35), with a slight summer maximum, and adjacent to its southern extremity is Dubbo (22·26), the rainfall of which is remarkably evenly distributed throughout the year, only a very slight increase being received during December and January.

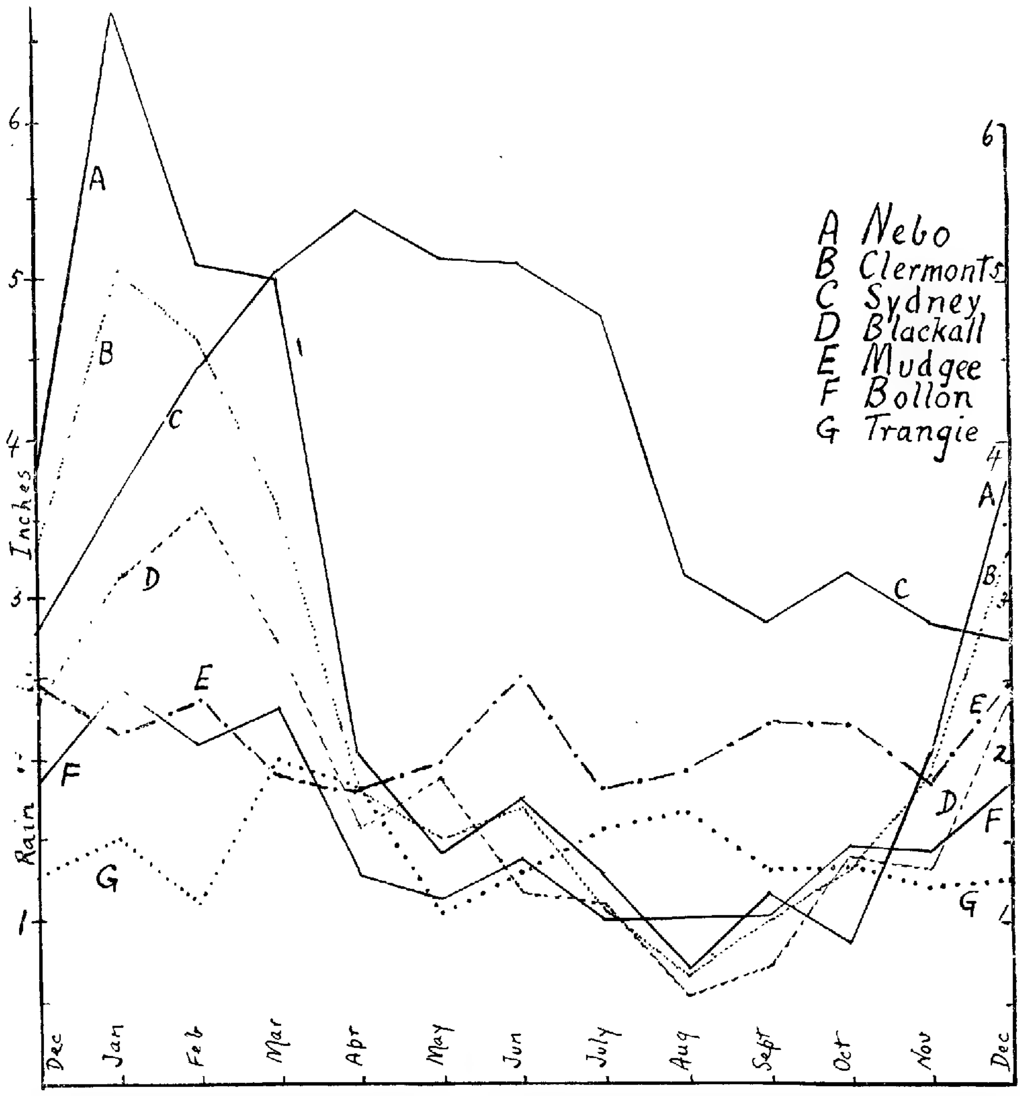
The rainfall of the regions surrounding the present pear zone in New South Wales may be indicated by that of the following towns:—Inverell (30·31) and Armidale (31·94), on the east, the latter being representative of the New England tableland; Mudgee (25·31) and Trangie (17·13), to the south of the area; Warren (18·03), Coonamble (19·76), and Walgett (18·78), just beyond its present western edge; and Nyngan (17·1) and Brewarrina (15·90), further westward. The coastal district, south of the Hunter River, receives its maximum rainfall in the autumn, March to July (*e.g.*, Sydney). It will be noticed that Armidale and Mudgee receive a well-distributed rainfall with a slight summer maximum in the former case, and a definite winter maximum in the latter. Trangie has a slight winter maximum; Coonamble a slight summer one.

On account of the more extensive invasion of territory in Queensland, a greater number of localities have been chosen to indicate the rainfall of that region. Clermont (27·57), Westwood (30·71), and Gracemere (30·78), the last-named being near Rockhampton (40·09), may be taken as representing conditions in the northern part of it, though the most northerly points (apart from coastal regions where *O. monacantha* has occurred) which prickly pear has reached (1923) are Nebo (31·54), about 50 miles south-west of Mackay, and the neighbourhood of Avon Downs (24·51), on the Sutton River, about 100 miles west of Nebo; Banana (28·07), Gayndah (30·61), and Toowoomba (35·70), its eastern edge, though there is an incursion into the Brisbane valley (Helidon, 29·41; southwardly from Laidley, 35·68, and Ipswich, 35·71; Brisbane,[4] 46·85). Warwick (28·78) marks approximately its southern limit in the direction of the New England tableland. Inglewood (27·87), Texas (27·14), Goondiwindi (25·57), and Dirranbandi (19·42) more or less mark its southern limits in the northern State, but the region between Texas and Mungindi (20·47) is continuous with the invaded area in northern New South Wales. Selected localities from the Queensland region are St. George (21·51), Morven (21·69), Roma (24·85), Yuleba (27·11), Dulacca (23·74), Chinchilla (27·02), Juandah (27·47), Taroom (27·69), Auburn (25·23), Hawkwood (29·22), Bauhinia Downs (28·86). Emerald (24·93) and Springsure (26·21) mark its present boundary to the north-west, except for the isolated invaded region surrounding Blackall (21·63) in central-western Queensland. The pear has now gained a foothold near Charleville (20·19) and Bollon (18·53), which mark its present westerly limit in southern Queensland. A line drawn from Mungindi on the New South Wales border to Charleville, thence to Springsure, Clermont, and Mackay, will be just westerly of almost all the prickly pear land in the northern State, if we omit the Blackall area. If we include the latter, then the 20-inch isohyet, as indicated by Taylor (fig. 127), practically coincides with this westerly boundary between Mungindi and Blackall, though there are extensions into the zone

(4) The average rainfall of the Brisbane district varies greatly, *e.g.*, that of the city is 46·85 inches; Wynnum, a seaside suburb, 40·75; Nudgee, another suburb only a few miles away and also close to Moreton Bay, has a rainfall (at Nundah) of 31·72. It is at Nudgee that the most abundant prickly pear in Brisbane district is to be found. The rainfall at the Toowoomba recording station is much greater than that received in the surrounding pear country, only a few miles away, where the average annual fall does not reach 30 inches, *e.g.*, Gowrie 29·88, Westbrook 27·69.

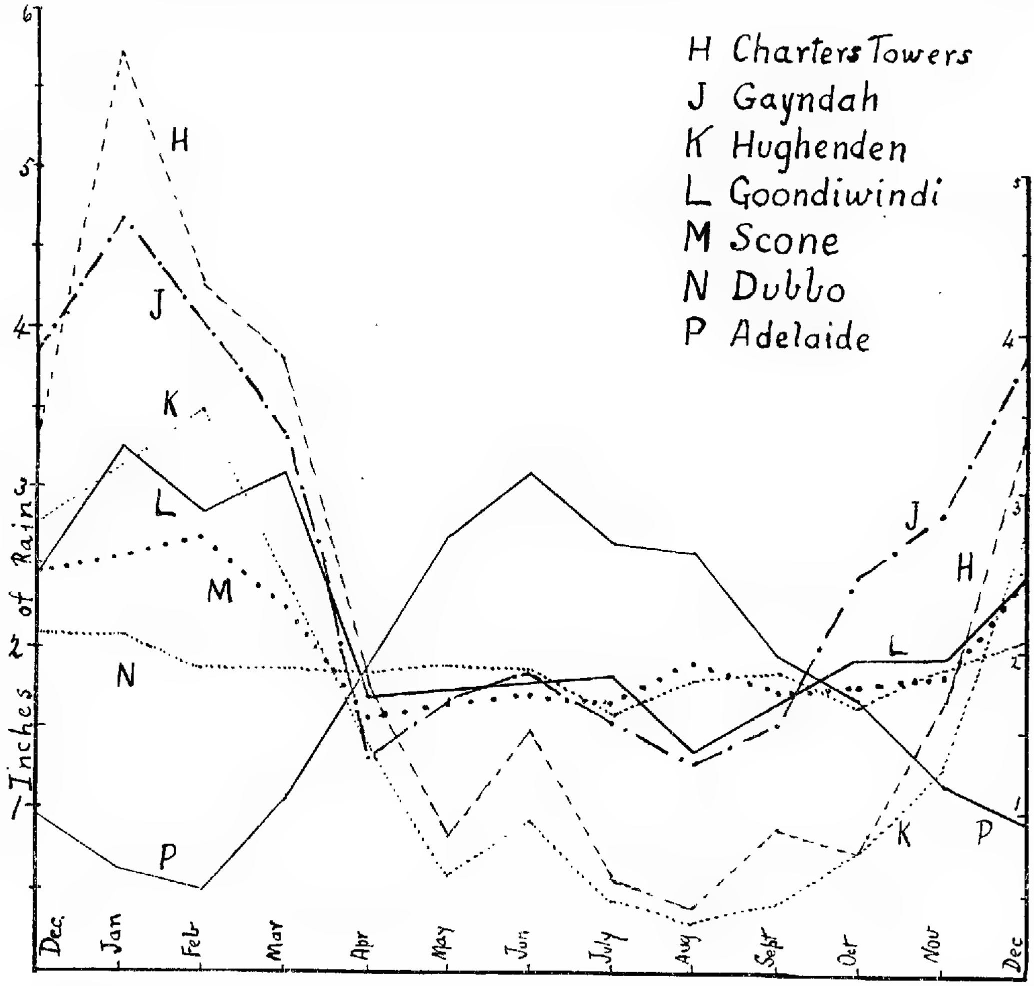
included between the 20- and 15-inch isohyets, Charleville and Blackall lying practically on the former. The mass of pear from Emerald eastward, towards Dingo (28·98), lies in a pronounced "bay" formed by the 25-inch isohyet, so that it is largely in a region having a rainfall between 20 and 25 inches.

We are now in a position to indicate the relation of the area, at present invaded, to certain climatological facts supplied by Hunt (1914, 1916) and Taylor (1918). Practically the whole of the infested region lies within the belt indicated by the latter (fig. 7) as receiving at least one inch during each of the twelve months of the year, the portion not included being the Blackall area and the country due west and to the north-west of Rockhampton, *i.e.*, the extreme northern and north-western parts of the pear region, but these lie within the zone which receives one inch for each of ten months per year.



Graph showing mean monthly rainfall at Nebo (present northern limit of pear); Bollon and Blackall (western limit in Queensland); Clermont (north-western limit); Trangie and Mudgee (just beyond its south western and southern limit); Sydney (as a type of the autumn rain occurring in the coastal region south of the prickly pear areas in New South Wales).

Practically the whole of the region, only the extreme northern part being excluded, lies in the region indicated by Taylor (fig. 127) as the "Brisbane Division" meteorologically, his northern and southern bounding lines coinciding to a remarkable degree with the boundaries of the pear area. It is a region receiving its rainfall distributed throughout the year but with a definite maximum in the summer period, from October, November, or December, to March. The southern border is marked by a line drawn between Newcastle and the north-western boundary of New South Wales. To the south of this line the rainfall inland ("Darling-Lachlan Division") is nearly uniform as to its monthly distribution, while nearer the coast ("Canberra Division") there is an autumn or winter preponderance. Still further south, as in South Australia, most of Victoria, and in south-western Australia, the fall is essentially a winter one (April or May to October), with a more or less dry summer. North of the northern boundary of the "Brisbane" climatic division, which is bounded by a line due west from Rockhampton, the rainfall assumes a definitely tropical character, *i.e.*, a very



Graph of mean monthly rainfall at Adelaide (as type of southern or winter rainfall); Dubbo (just south of the prickly pear region); Goondiwindi and Scone (fairly typical of the rainfall in the infested parts of Queensland and New South Wales; Gayndah (near the eastern limit); Charters Towers (near its probable northern limit); Hughenden (typical of that portion of western Queensland which will probably remain uninfested).

heavy summer preponderance with a more or less scanty winter component ("Townsville Division"). This is also true of the region lying to the west of the western limit of the region.

Typical graphs showing the essential features of the rainfall of the invaded territory and the surrounding areas are included in this paper. It has already been mentioned that the pear region, as a whole, has its western boundary very near the 20-inch annual isohyet, as indicated by Taylor and by Hunt (1916), while the eastern limit is almost exactly indicated by the 30-inch isohyet, prickly pear occurring outside these boundaries chiefly as scattered plants, though in some places both in Queensland and northern New South Wales active invasion of the region between the 15- and 20-inch isohyet is now taking place. Plants occur commonly in the coastal zone of the region, but do not grow in such a way as to constitute a pest. It might be remarked that these plants may be found quite close to the coast, or even beside the sea, but such situations, though receiving a high average annual rainfall (40 inches and upwards, *e.g.*, Emu Park, 43·35), may be relatively dry from the point of view of plant physiology. The 30-inch isohyet makes a detour towards the coast in the Fitzroy valley (Westwood 30·71, Stanwell 30·99), and also in the upper Burnett valley (reaching Degilbo 28·13), its limits being practically coincident with the pear infestation of those regions, while a similar state of affairs occurs in part of the Brisbane valley, the isohyet approaching within a few miles to the south of Helidon, Laidley, and Ipswich, where infestation is also present. The heaviest invasion, both in regard to density of growth and area affected, has taken place in the region between the 25- and 30-inch isohyets in Queensland, but there is a fairly even distribution between the 20- and 30-inch lines in the northern half of the infected portion of New South Wales. In the latter State the 30-inch isohyet follows the main range on its western slopes fairly closely, but makes a westerly detour to round part of the Warrumbungle Range, and then travels down the Hunter-Goulburn Valley almost to Maitland, thence south-westerly towards Orange. This incursion into the Hunter valley coincides with the limits of the Goulburn-Hunter prickly pear region, most of which lies within a similar tongue-like area bounded by the 25-inch isohyet (Scone 23·67, Muswellbrook 23·46, Denman 23·12, Merriwa 22·69, Singleton 29·54). The 30-inch isohyet in New South Wales lies just east of Texas (27·14), on the Queensland border, west of Inverell (30·60) and close to Bingara (30·49), Bundarra (29·71), and Tamworth (27·72), the first, third, and fifth-named places being located practically on the present eastern margin of the invaded region. The 20-inch isohyet in Queensland has already been referred to. In New South Wales it passes through Mungindi (20·47), thence southerly to the west of the Pilliga area, just easterly from Coonamble (19·76), Warren (17·99), Nevertire (17·92), and Narromine (18·44), but includes Trangie (20·53) and Dubbo (22·38). The relation of these districts to the invaded region has already been noted. Only a very small part of the pear zone in New South Wales lies westerly from the 20-inch isohyet.

There are a few small areas in New South Wales where pear is common and which lie outside the limits mentioned above. There is a region drained by the headwaters of the Clarence River, north of Tabulam (38·91) and Drake 40·82), recording stations in the vicinity of the area being Rivertree (32·25) and Maryland (34·43). This region, like that of the Scone district, has not appreciably extended since 1911, though the infestation may have become rather more dense. Another area is in the vicinity of Camden (30·19) and Campbelltown (27·48), south-west of Sydney. This is very restricted and has not increased to any extent. The 30-inch isohyet (Hunt, 1916) projects easterly in this locality to include a tongue of comparatively drier country surrounded by

a region having a rainfall between 30 and 40 inches. Certain species of Opuntia occur at Windsor which has an annual average of 30·75 inches.

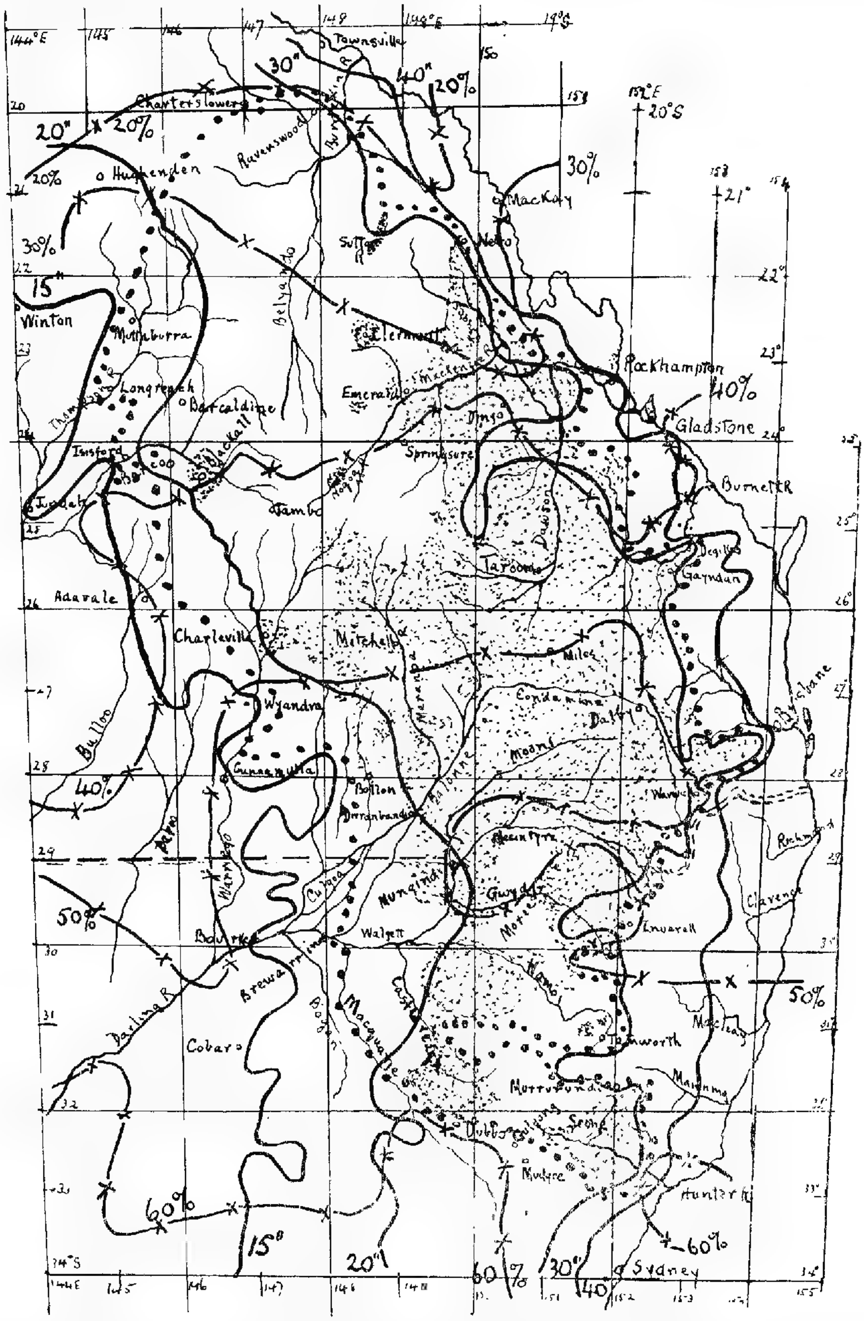
The period in which the rainfall occurs is of very great importance to plant life. Only that part is of utility which falls during the growing season of the plant (no matter what time of the year that may be), or which may be stored up in the soil and thus become available. The period from April to October, inclusive, which is the growing period for wheat, is commonly taken in Australia as a winter period; but it must be emphasised that, though cacti are dormant during the winter (from June to September, or even later) they are able to utilise both autumn and spring rains. Hence the percentage distribution of the rainfall according as it falls in the five months period, November to March (summer rain), or the seven months period, April to October (winter rain), does not express the percentage of rain available for cactus growth. Thus a 15-inch rainfall received mainly in the summer period would be of more use to such a plant than a much heavier fall received mainly in the autumn and winter months, since, in the latter case, the summer rainfall would be much lighter and the summer period itself shorter, both factors considerably limiting the growth and reproduction of prickly pear.

Hunt's maps (1914, 1916), showing the average rainfall received during the wheat-growing period (April to October, inclusive), indicate that the greater part of the region invaded by the pest lies between the isopleths for 10 and 15 inches, the latter lines corresponding very closely with the 30-inch average isohyet (Taylor, fig. 127). In New South Wales the 15-inch winter isopleth extends from the northern border near Texas, close to Bundarra (14·75) and Inverell (15·23), to the Scone-Merriwa region, thence down the Hunter valley and turning west to Wellington, where it meets the line indicating that 60 per cent. of the total annual rainfall is received during the period (April-October), Dubbo being situated to the north-west of the junction. Except for a very small area near Singleton, pear is not a pest in any part of New South Wales receiving an average of more than 15 inches during that period. It is chiefly the western third of the invaded region in Queensland which lies outside this 15-inch winter isopleth. The 10-inch winter isopleth lies just east of Warren, Walgett, Collarenebri, and Mungindi, thence more or less due north to Dingo and St. Lawrence, the Queensland portion thus lying a little east of 149° E.

The relation of the amount of winter rainfall to the total is also of interest. All the pear areas except a few northerly outliers are situated in the region where the April-October *(i.e.,* autumn, winter, and spring) rainfall constitutes not less than 30 per cent. of the total; and most of it receives, at least, 40 per cent. during that period. The 40 per cent. isopleth travels more or less easterly near Blackall, Tambo, Springsure, Dingo, Banana, Eidsvold, Rosedale, and Gladstone. The region receiving between 40 and 50 per cent. of its total during the winter period includes the northern Maranoa, Taroom district, most of the Burnett area, eastern Darling Downs, and a large part of the northern pear region of New South Wales.

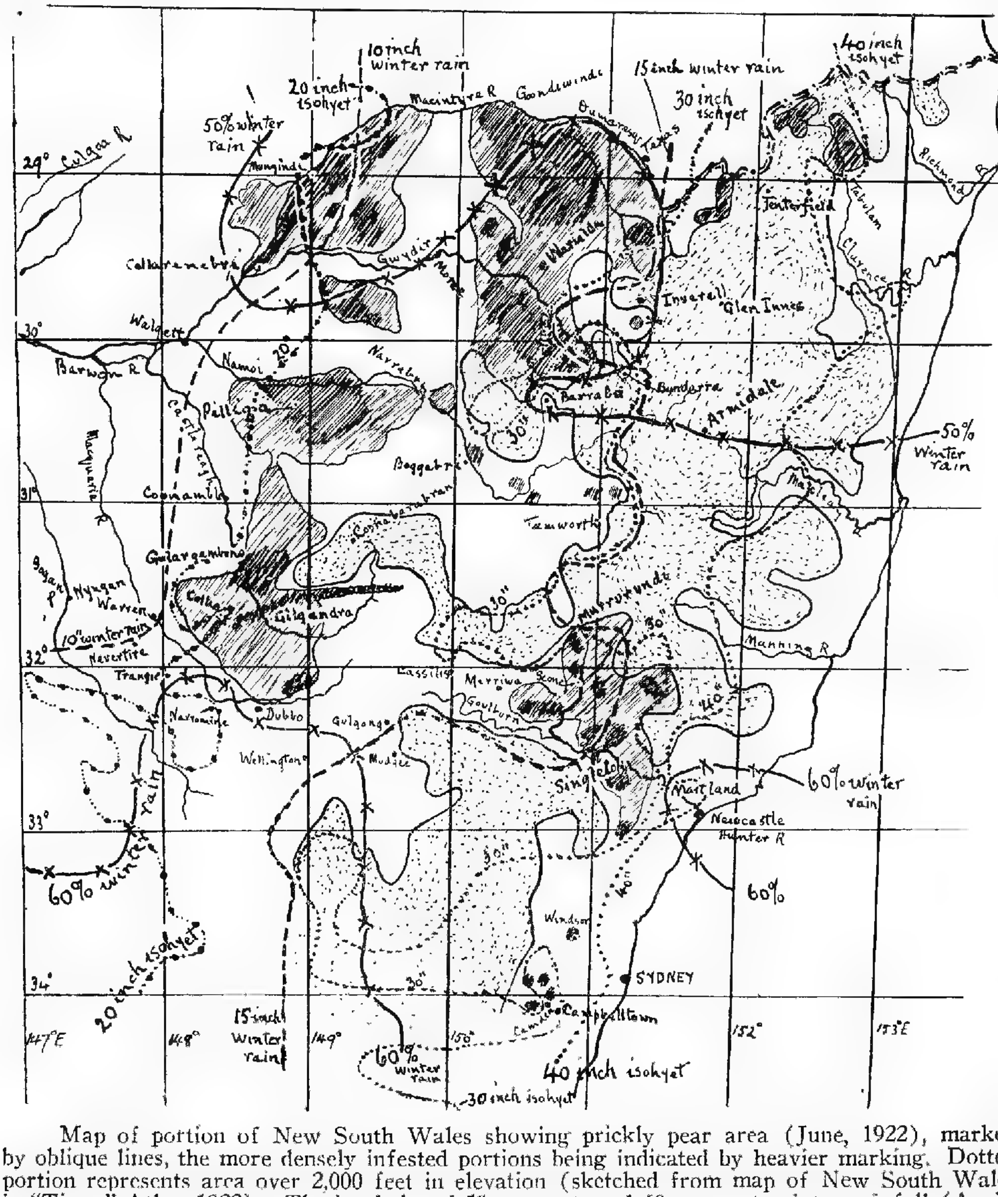
The 50 per cent. isopleth for the wheat-growing period is indicated by a line drawn from the vicinity of Bourke to Cunnamulla, and bearing east about midway between Wyandra and Mitchell, thence through Yuleba and Miles, bending northerly and then southerly to Dalby, continuing near Warwick, then turning westerly near the New South Wales border, curving across the latter west of Mungindi, thence between Walgett and Collarenebri, through Moree, north-west to Texas, southwards through Inverell and Bundara, and eastwards through Armidale to the sea. Most of the infested region in New South Wales and the south-westerly part of the pear area in Queensland receive between 50 per cent.

and 60 per cent. of their rainfall during the seven months April-October, the isopleth marking the northern boundary of the 60 per cent. winter fall taking an irregular course, passing in the vicinity of Trangie and Narromine, thence north of the latter, thence south-east to a point just south of Dubbo, thence to the



Map of part of Eastern Australia to indicate relationship of prickly pear infestation to rainfall. The probable limit of the infestation, if left unchecked except by climatic control, is shown by a dotted line. 15, 20, 30, and 40 inch isohyets; also 20, 30, 40, 50, and 60 per cent. winter rainfall (April October) isopleths (from Hunt) are indicated. Infested area dotted.

north of Wellington and to the west of Mudgee, thence southwards. It will be noted that this line nearly coincides with, but lies to the south of, the southern limit of the pear belt. The Camden area has a winter rainfall between 15 and 20 inches constituting from 50 to 60 per cent. of the total, which is similar to that experienced in the Hunter Valley.



Map of portion of New South Wales showing prickly pear area (June, 1922), marked by oblique lines, the more densely infested portions being indicated by heavier marking. Dotted portion represents area over 2,000 feet in elevation (sketched from map of New South Wales in "Times" Atlas, 1922). The isopleths of 50 per cent. and 60 per cent. winter rainfall (April-October); 10 and 15 inch winter rainfall; and also 20, 30, and 40 inch isohyets are indicated.

The following recorded average rainfalls for the April-October period, together with the calculated percentage of the total annual fall, relating to a number of towns in the pear region of New South Wales, lying between the 50 and 60 per cent. isopleths and in their vicinity, may be of interest:—Boggabilla, 11·15 (46·4 per cent.); Mungindi, 9·49 (46·3); Moree, 11·59 (49·4);

Warialda, 13·57 (48); Collarenebri, 9·05 (47·8); Bingara, 15·56 (51); Pilliga, 11·10 (54); Narrabri, 13·40 (51·7); Tamworth, 14·62 (52·8). Near the southern limit of the invaded zone are Scone, 11·92 (50·3); Cassilis, 12·36 (52); Gilgandra, 14·14 (57·2). To the east of it is Inverell, 15·23 (50·2). To the south of it, Dubbo, 12·76 (57·3); Gulgong, 14·79 (57·1). Adjacent to the south-west of it, Trangie, 11·44 (66·7); Warren, 9·73 (54); and to the west of it, Coonamble, 10·72 (54·4), and Walgett, 9·76 (52). Except the infested area just north of Dubbo and situated in the vicinity of Gilgandra, all the pear regions apparently receive not more than 55 per cent. of their supply of rain during the winter (April to October).

Altitude.—The prickly pear region shows some relationship to altitude which is not unexpected, since the Main Dividing Range is largely responsible for the position of the isohyets in eastern Australia. Most of the infested territory occurs on the western slopes of the range and lies at an elevation between 1,000 and 2,000 feet above sea level, extending into the western plains (500 to 1,000 feet), but not occurring on the New England plateau (from a point just south of Warwick southwards), where the elevation is over 3,000 feet, while the region between 2,000 and 3,000 feet in elevation is practically, if not quite, free from the pest. The infected portion of the valleys of the Burnett and Brisbane Rivers is less than 500 feet above seal level. The limits of these elevations are broadly indicated by Taylor (fig. 127). The more or less isolated condition of parts of the eastern portion of the area in New South Wales is seen to be very definitely related to land contours. The New England tableland, from the Queensland border to Murrurundi, has an altitude of not less than 2,000 feet, and extends quite close to the coast in many places north of the Hunter River. On the western side it has rather narrow prolongations which dissect the prickly pear region, the most pronounced being the Nandewar Range, which extends westwards between Bundarra on the north and Narrabri-Tamworth detached pear areas on the south, and a much larger mass, the Warrumbungle Range, which extends westwardly from Murrurundi beyond Coonabarabran and forming a boundary for the south-western pear region. The Hunter-Goulburn area lies in a less elevated tract bounded closely by tablelands over 2,000 feet (Mount Royal, Liverpool, and Hunter Ranges), so that it forms a comparatively narrow region communicating with the western plains beyond Merriwa and Cassilis. The only part of the pear area in New South Wales which lies at a greater elevation than 2,000 feet is a small detached district adjacent to the Queensland border, in the headwaters of the Clarence River (near Maryland), while the neighbouring infested region (just north of Tabulam) lies below that elevation.

The effect of elevation is not so marked in Queensland, probably on account of the higher temperatures compared with those in New South Wales. Besides, the total area over 2,000 feet in height is relatively small in comparison with that in the Southern State, and in great part lies a long distance inland. There is a small northward extension of the New England plateau reaching Dalveen, and in this region pear is absent. The Main Range, which is a very narrow continuation of the plateau, tends northwards and then westerly as the Bunya Mountains. Scattered or dense pear occurs at intervals along one or other or both sides of these ranges, but the northerly extension (Main Dividing Range) beyond the Upper Maranoa watershed traverses a region almost free from pear at present, there being only a few small isolated infected areas, *e.g.*, Nogoa River and Buckland Creek, a little near Springsure, and some east of Withersfield. An elevation of 2,000 feet in Queensland presents no striking line of demarcation between infested and pear-free territory. It may be pointed out that the greater part of the invaded region in that State lies at an altitude less than 1,000 feet.

Watershed.—It may be noted that, apart from the comparatively small areas situated in the Burnett, Brisbane, and Hunter valleys, nearly the whole of the invaded territory is drained by two river systems, *viz.*, the large streams Isaacs, Mackenzie, and Dawson, which form the Fitzroy, and the extensive rivers which belong to the Darling basin. Amongst the latter may be mentioned the Condamine, Dumaresq, Macintyre, Barwon, Gwydir, Namoi, Castlereagh, Balonne, Maranoa, and Mooni. The upper part of the Warrego watershed is infected, as also are some of the creeks situated between the Warrego and the Balonne. The Blackall area, however, lies in the Barcoo watershed.

Temperature.—The average January (midsummer) temperature of the various parts of the pear region as indicated in Bartholomew's Physical Atlas (Vol. iii., Meteorology) lies between 77·5° F. and 80° F. in the case of the area including Brisbane, Toowoomba, Warwick, and most of the invaded portion of southern Queensland, while that of the New South Wales section lies between 80° F. and 85° F. The average July (midwinter) temperature in the Darling Downs area and the adjacent tracts in New South Wales lies between 55° F. and 57·5° F.; in the remaining pear regions of New South Wales, 52·5 to 55° F.; in the area lying north of a line drawn through Brisbane and Dalby (Darling Downs), 57·5°F. and upwards. The average annual temperature of the Darling Downs and New South Wales areas lies between 67·5° F. and 70° F.; of the area from Brisbane and Dalby northward, 70° F. to 75° F., most of it falling between the 70° F. and 72·5° F. annual isotherms.

Frost.—The frost map of Australia (Hunt) indicates that the western and most of the northern parts of the region infested with pear are subject to frequent frosts during the months May to September; while the eastern, central, and southern portions experience such a condition from April or May to September or October, *i.e.*, for five, six, or seven months, according to the locality. In the coastal belt in southern Queensland and northern New South Wales, frost occurs from June to August, just as happens at Blackall. The northernmost portion (north of Emerald) experiences frost from May to August; and the southernmost, the Hunter valley, from April to October, a period during which most of the New South Wales pear areas and part of the region which lies in Queensland are also subjected to it.

Vegetation.—If the prickly pear area be compared with Taylor's "Vegetation Map" (fig. 10) it will be noticed that it falls in the three regions marked respectively as savannah forest, brigalow, and savannah plus brigalow. There is, practically, none in the typical savannah country, whereas the pest thrives in the open timbered region (forest or brigalow). The line indicating the eastern limit of the savannah, or the western limit of the mixture of savannah and brigalow or forest, marks out very closely the westerly boundary of the prickly pear. It seems, then, that the climatic conditions which lead to the formation of a savannah and to the absence of timber, are such as limit the growth of prickly pear. This savannah region is indicated by Taylor (1918, p. 28) as possessing a rainfall between 10 and 20 inches annual average, received during the summer in the north and the winter in the south, and as having an annual temperature of 70° F. to 90° F. in January and 45° F. to 75° F. in July. It has less rainfall and much wider extremes of temperature than the brigalow or savannah forest. The brigalow region has a rainfall of 10 to 20 inches, chiefly in summer, with an average temperature ranging from 85° F. to 88° F. in January, and 55° F. to 70° F. in July. The savannah forest contains a goodly quantity of grass in addition to the dominant tree flora, such as eucalyptus and acacias; receives its rain (15 to 50 inches) in the north chiefly in summer, but more uniformly in the east; and has an average range of temperature 75° F. to 88° F. in January,

and 45° F. to 75° F. in July. The higher rainfall and temperatures belong to the northern portion of this region which lies beyond the pear areas.

Summary.—The prickly pear region in eastern Australia may be said to occupy that portion which has an average annual temperature between 67° F. and 75° F., the mean minimum for midwinter being 52·5° F., which has an annual average rainfall between 20 and 30 inches, received especially during the five summer months, the wettest months being during summer (40 to 70 per cent. of the yearly total), but with an inch or more during most of the winter months; which lies definitely to the north of the line indicating uniform rainfall distribution throughout the year; which has an elevation less than 3,000 (mostly less than 2,000 feet); which is liable to experience frost for from five to seven months in the year; and whose natural vegetation may be classed as a "brigalow forest" or as a "savannah forest" and not as a more or less pure savannah (practically treeless grassland).

Homoclimes of Australian Pear Region.—The homoclimes of the "Brisbane Division" which includes this pear region, are stated by Taylor (1918, p. 128) to be found in East Cape Colony, Uruguay, and south-eastern United States, America, which all have a mean annual temperature of about 70° F., with a mean annual range of about 20° F. in Uruguay and 30° F. to 40° F. in the United States, America; but the Australian maximum is greater than that of the others. All have the same type of rainfall with a midsummer maximum, though the United States, America, and Uruguay receive more rain during winter. It is of interest to note that some of the species of Opuntia naturalised in Australia are native of Uruguay and south-eastern United States, America, while eastern Cape Colony has a prickly pear problem of its own. It is worthy of note that Taylor (p. 14, 156) has listed Montevideo as a homoclime of both Sydney and Brisbane regions. Except for its greater rainfall (38 inches) it would agree with the Hunter pear area. The places mentioned by Taylor resemble the southernmost part of the pear area of "Brisbane Division" rather than the remainder of it. The homoclimes of western New South Wales, which has a comparatively uniform rainfall and which borders on the south-western edge of the pear belt, include, according to Taylor (p. 140), San Antonio, in Texas, with an average rainfall of 25·2 inches and an average annual temperature of 67·8° F. (range 51° to 82·4°), and Cordoba, in eastern Argentina (25·2 inches rainfall, 62·4° F. mean annual temperature). The former is situated in southern Texas and marks, approximately, the northern limit of heavy Opuntia growth in that portion of the United States, America, while its climate (temperature and rainfall) is practically identical with that of the Narrabri, Pilliga, or Scone prickly pear regions in New South Wales, so that San Antonio is really a homoclime of the southern regions of the "Brisbane Division" rather than the adjacent north-eastern part of the Darling-Lachlan division. The data available to the writer regarding Cordoba show that it receives its maximum rain in summer, its average rainfall and its temperature being that of the southern pear region in Australia, so that Cordoba, like San Antonio, is a homoclime of Scone and Pilliga districts.

Another homoclime mentioned by Taylor is Oklahoma, with a rainfall of 28 inches and an average annual temperature of 58·6° F., ranging from 54° F. to 80° F. This is definitely outside the pear belt [5] of the United States.

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[5] The terms "pear belt" or "pear region" are used in this paper to denote areas where Opuntias thrive and occur abundantly. In the New World the genus is very widely distributed, but it is in certain portions of it situated between Florida and southernmost California, as a northern boundary, and Mendoza (Argentina) to Uruguay, as its southern, that the plants reach their maximum in regard to number of species and of individuals.

America, and though the rainfall is such as would promote good growth of Opuntia, the limiting factor must be the lower average annual temperature, and especially the cold winter.

The "Canberra Division" (taking Sydney as typical) has for its homoclimes, according to Taylor, Port Elizabeth (Cape Colony), Montevideo (Uruguay), and Wilmington (N. Carolina). It is of interest to note that Sydney is definitely outside the typical prickly pear area, and this is true of the Port Elizabeth district, though a Uruguayan Opuntia occurs close to the latter, as it does in the Hunter valley. Carolina is just beyond the eastern United States, America, pear region, which ends in South Carolina or eastern Florida. This particular region and its homoclimes are of importance, as they must possess some feature or features which are not favourable for the spread of prickly pear. Sydney district is the oldest settled part of Australia and has several species of Opuntia (including the pest pear and *O. aurantiaca)* growing wild in its vicinity, and yet they have not spread, though locally more prevalent at Camden and Windsor. The factor is certainly neither that of temperature nor altitude, but is most probably that of rainfall. The latter is apparently excessive along the coastal zone for the naturalised species, but this would not explain the absence of the pest along the northern boundary of the "Canberra Division," where the amount received annually is similar to that of the adjacent pear areas in northern New South Wales. It is then, practically certain that the primary limiting factor is the amount of rainfall received during that period (summer) in which seed germination and active growth and reproduction of the plant occur. A dry summer largely prevents these from taking place. An excessive rainfall (over 35 inches —probably over 32) also seems to be detrimental to most species, though it must be emphasised that it is not the total rainfall (whether great or small) which is a true index to the plants' needs, but rather that part of it which they can utilise. Imperfect soil drainage is highly detrimental to most cacti.

The "Adelaide Division," as well as "Swanland" (south-west of Western Australia) has a single winter maximum and a single summer minimum rainfall, and possesses a climate like that of Cape Town, Valparaiso (Chile), and a great part of the Mediterranean region. The "Victorian Division" is essentially the same, except for an increased summer component in the rainfall, especially in the eastern portion. The Mediterranean is the only one of these localities in which Opuntias are abundant, but it must not be forgotten that the chief species occurring there are such as produce an edible fruit which enters largely into the human dietary in the region, so that the plant is one which is afforded every opportunity by man for its spread by seed or by vegetative propagation, and yet it has not overrun the area to the exclusion of other vegetation. The obvious reason is that the Mediterranean, like the southern part of Australia, is a region of winter rainfall, with comparatively dry summer.

We have examined the Australian prickly pear region in regard to its climatic conditions and have compared it with certain other parts of the world. We may now make a brief survey of the conditions occurring in the pear regions of the Old and New Worlds, in order to ascertain, if possible, the direction in which further extension of the pest in Australia is likely to take place, assuming that it is not controlled in some other way, e.g., by biological, chemical, mechanical, or administrative agencies. Taylor (1923, figs. 7, 8, 12) has published some diagrams comparing the Australian climatic zones with those of North America, Northern Africa, and India. The Australian pear region corresponds in latitude with Mexico, Florida, and the Gulf States of the United States, America, while the Barbary States, of northern Africa, are shown as corresponding climatically with the southern part of the Commonwealth.

Climatic Requirements of Prickly Pears.

A certain amount of work has been done on the climatic requirements of prickly pears in the United States, America. In 1896 Coulter pointed out that the majority of species of flat Opuntias then known to occur in the United States, America, were found in its south-western portion, Texas leading in regard to the number of species, with New Mexico next, Arizona third, followed by southern California. In 1905 Griffiths mentioned that the northern boundary of the cactus area in the United States, America, extended from the Texas-Louisiana line, westward, along 33° N. to the Texas-New Mexico border, thence north to 39° N., thence west, but the great Opuntia region comprised that part of Texas lying south of 30° N., since in southern California, Arizona, and New Mexico there were either comparatively few individuals, or else they were relatively small. In 1906 Griffiths and Hare stated that prickly pears throve best in a region which had a relatively equable temperature and a considerable rainfall periodically distributed; that these plants occurred naturally and in the greatest profusion on the Mexican plateau, but that the region was not hot, and, though very dry during a large part of the year, yet it had a considerable average rainfall, that of Zacatecas for ten years being 31·5 inches, distributed as follows: from January to April and from October to December only, ·62 to 2·12 inches, while the average for the remaining months was from 3·5 to 7·12 inches per month, June, July, and August (*i.e.*, summer) having 4·25 to 7·12 inches each (1906, pp. 29, 30). The information was republished in another article by these authors in 1907. Next year Griffiths, in discussing the value of prickly pear as a farm crop in southern Texas, published the monthly rainfall of San Antonio for a period of ten years, showing a marked preponderance of summer rain (April to July), but with irregular distribution during the remaining months, the average annual fall (18 years) being 28·4 inches. He pointed out that these plants were especially adapted to regions where the rainfall was considerable though irregularly or periodically distributed, and that the popular belief that they would grow with little or no water was incorrect. A high average temperature during summer was held to be an advantage for their growth (1908, pp. 8-10). In dealing with the so-called "spineless" prickly pears (1909, pp. 15-17), he indicated the region in the United States, America, where these Mexcian species might be grown (the Gulf Coast from Florida to the Rio Grande; southern Arizona to the Sacramento valley, in California), the minimum winter temperatures experienced outside these areas preventing their growth, but stated that cultivation was necessary in the Sacramento valley to conserve sufficient moisture in the soil after the spring rains had ceased. In a subsequent publication (1912), recording later observations, he very greatly reduced his estimate of the extent of territory favourable for the growth of these plants. A temperature of 20° F., if continued for any length of time, was regarded as fatal to them. He went on to state (p. 12) that ideal conditions for spineless as well as spiny prickly pears were found on the highlands of Mexico where there were two rainy seasons, one in winter, and the other, more pronounced, in summer, while over much of the region a minimum temperature of 25° F. was seldom experienced.

In 1911 Wooton, who studied the cactus flora of New Mexico, referred to the extensive shallow rooting system of these plants making possible a rapid absorption of moisture which in arid regions is received from rainfall mostly torrential in character. He also pointed out that though cacti were able to endure great daily and annual ranges of temperature, they were adapted to a region where the temperature was moderately high but not excessive, where the minimum was not very low (though a minority of the species could withstand continued and severe freezing), and where the rainfall was periodic and moderate in amount, with intervening periods of drought. New Mexico possessed climatic

conditions which were not favourable for most species, being too cold or too dry, so that cacti formed a subordinate part of the vegetation of that State, though they were obvious on account of their striking appearance. The temperature and rainfall varied greatly in different parts, low precipitation being associated with warmer temperatures and higher rainfall with colder weather, so that the necessary amount of rain and degree of temperature were not available at the same time.

Thornber (1911) published information regarding the behaviour of cacti in Arizona, where there are two periods of growth (at lower altitudes), one in spring and early summer following closely on the winter rains, and the other during the rainy season in summer, when moderate to heavy rains occur, a shortage in either winter or summer rains causing a check in cactus growth. These plants are dormant during the dry spring and summer months, and also October to February inclusive (winter), as well as during any prolonged drought, though flowering and fruiting may take place. The destructive effect of grass fires on young cacti was noted.

In the preceding year this author (1910) published considerable climatological data regarding certain localities in Arizona. In the eastern and south-western portions the summer rainfall (July to September) exceeds that of the winter and early spring (November or December to March) and is usually over one-half the total, while in the region north and west of Tucson the spring and winter rainfall is the greater. At Tucson the latter averages about an inch below that of the summer; April, May, and June are very dry months, while October and November are also dry; the annual average being 10·76. In the Pacific Coast States the rainy season occurs during the winter and spring months.

In 1913 Griffiths published the results of his observations on the behaviour of Opuntias under cultural conditions, mentioning that some inland species did not thrive when grown at Brownsville, in southernmost Texas, where the climate was too humid for them, though those from the central Mexican highlands were found to be hardy at Brownsville, as well as at Chico in northern California, where there was a heavy winter rainfall. Species of Nopalea and also Opuntias from southern Mexico did not grow in Texas (Brownsville and San Antonio) or California (Chico), unless protected against winter.

The climatological data to be presented in the succeeding part of this paper are gathered from Bartholomew's Physical Atlas, vol. 3; Kendrew (1922); Thurston (1913); Douie (1916); O'Malley (1917); and the official year books of South Africa (1922, 1923), especially the first two named. It is intended to review the climatic conditions, firstly, in the pear regions in the vicinity of the Gulf of Mexico and Caribbean Sea (since most of the pest species are natives of that habitat); then those in South America (from which a few widely acclimatised species have been derived); and lastly, those of the regions where cacti have become thoroughly acclimatised such as India, Ceylon, South Africa, and the Mediterranean littoral.

North America and West Indies.—The average annual rainfall of Florida and the Gulf Coast of the United States, America, except Texas, is between 40 and 60 inches (Key West, 38). It is well distributed in summer and winter with a slight maximum in late summer, but very little falls in autumn (October) and spring (April). The central region of North America, including most of Texas and Mexico, has its maximum in early summer (June) with little rain in winter, December and January being dry. The eastern portion of Texas, including Austin and Brownsville, receives 30 to 40 inches; central Texas, including San Antonio, 20 to 30; while western Texas, part of Arizona and New Mexico, also southern California, receive 10 to 20 inches; the remainder of Arizona and New Mexico, under 10 inches per annum. The 10- to 20-inch

isohyets include the Rio Grande region of northern Mexico. This Arizona type of rainfall is the result of two influences, the Pacific supplying a maximum in winter and an intense local heating in late summer causing showers in July and August, while June is practically rainless. A table of average monthly rainfall at three centres in southern United States, America, *viz.*, Miami (Florida), San Antonio (Texas), and San Diego (southern California), published by Kendrew, shows the marked summer preponderance at the two former and an almost rainless summer in southern California (9·6 inches annual average). From 35 per cent. to 40 per cent. of the annual total is received during the summer period, July to September, on the south and east coasts of Florida; 30 to 40 per cent. in west-central Texas, Arizona, and New Mexico in July and August; and 40 per cent. in western Texas and the adjacent northern portion of Mexico (Chihuahua), chiefly from July to September. The Mexican mean annual rainfall varies from 10 to 20 inches in part of the north (Chihuahua city, 24·2) and centre extending to San Luis Potosi; 20 to 30 inches in the belt surrounding that region and including Mexico city (23·1) and most of northern Mexico; 30 to 40 inches in the more southerly portion (Zacatecas 31, Durango, and Tehuantepec).

Southern and south-western Cuba and southern Haiti (the pear regions of these islands and the home of *O. inermis)* have an annual fall of 40 to 60 inches, part of Jamaica (Kingston) 30 to 35 inches, but most of the West Indies have a higher rainfall. Prickly pear is abundant, especially on the smaller islands and particularly along the coast of nearly all, but, as already pointed out, the marine littoral is typically a dry region from the point of view of plant ecology or physiology, on account of the increased salinity. The rainfall in the West Indies is essentially a summer and autumn one –June to December, especially August to December. On the Venezuelan coast and Trinidad there are two periods of heavy rainfall, *i.e.*, the equatorial type like that of central Africa.

The midwinter (January) average temperatures (in Fahrenheit) of the region are as follow:—Key West 68°, Miami 64°-68°, western Florida 55°, San Antonio 50°-53°, Brownsville 61°, Tucson 56°, San Luis Potosi 71·6°, Zacatecas 69°-71°, Chihuahua 57°; while the Gulf coasts and the region between Savannah (South Carolina) and Monterey (California), and lying well to the north of the pear zone, have an isotherm of not less than 10° C. (50° F.) during that month. The average temperature in midsummer (July) at San Luis, Potosi, Zacatecas, Brownsville, and San Antonio is 86°; Chihuahua and Tucson, 93°; Louisiana, Alabama, Carolina, Florida, and the Gulf Coast generally, 79° to 82°. The 68° F. (20° C.) isotherm of average annual temperature includes Florida, the Gulf Coast, a large part of Texas (from Austin southwards) and southern Arizona, but lies to the south of southern California.

The main prickly pear region of North America is, then, limited northwards by a mean annual isotherm of nearly 70° F., with a mean midwinter (January) isotherm of not less than 50°, and a mean midsummer (July, August) temperature of at least 80° F. The chief pear region of Mexico has an average temperature between 60° and 70° in January, and about 90° F. in July, with a mean annual average between 70° and 80°. The West Indian Islands have an almost equable temperature, the average ranging from 79° in January to 82·5° in July.

South America.—The maximum rainfall occurs in the winter along the Pacific Coast, but during summer along the eastern Andean slopes (Peru to Mendoza) and in northern Argentina (to Buenos Aires), 35° S. marking approximately the limit of summer rain maxima, and this is almost exactly the southern limit of the region where good pear growth takes place in that continent

(see Kendrew for graphs of monthly rainfall of parts of Argentina, including that of Mendoza district, which is under 10 inches).

In the dry Caatinga—a "thornveld" region rich in cacti, especially Cereoids—inland from Bahia, in north Brazil, the rainfall is scanty (10 to 20 inches) and occurs in summer and autumn, there being six almost rainless winter months and a very great variation in the annual amount.

Southern Uruguay and that part of Argentina (Bahia Blanca) which lies to the south of it, have a comparatively uniform rainfall (20 to 30 inches) with a slight winter maximum, though that of Montevideo (38·5) is practically uniform, as the following monthly averages, commencing with January, show:—3·2, 2·4, 3·5, 3·4, 3·9, 3·3, 3·3, 2·7, 3·1, 3·7, 3·0, 3·1 inches, while Buenos Aires, though only a short distance away, has a definite summer maximum (December, January, and March). The coastal region of Brazil and the adjacent districts, which constitute the native home of *Opuntia monacantha,* have a high average rainfall, 40 to 80 inches, with a definite summer maximum *(e.g.,* Rio Janeiro's monthly averages, from July onwards, are 5·0, 4·3, 5·3, 4·4, 3·5, 2·0, 1·6, 1·8, 2·6, 3·2, 4·3, 5·4; total, 43·4 inches).

The midsummer (January) average temperature is about 80° F. for almost the whole of the pear region, the Andean portion and Uruguay lying between the 70° and 80° isotherms, but much nearer the latter. In July, southern Brazil and northern Argentina lie between the 60° and 70° F. isotherms, while the central region of the latter, as well as Uruguay, falls between the 50° and 60° isotherms. The main Opuntia areas of South America have an average annual temperature between 65° and 73° F., corresponding extremely closely with the range exhibited in the Australian area.

India and Ceylon.—The portions of India which have permitted good growth of *O. monacantha* are those with a heavy rainfall, *e.g.,* the Gangetic plains where the species was formerly rather abundant. The regions in which either *O. elatior, O. dillenii,* or the "Punjab pear" is prevalent, *viz.,* portions of the Punjab *(e.g.,* Lahore, 20·7; Jullundur, Delhi, 27·7; Jaipur, 25·0), United Provinces, Central India, Deccan, northern Mysore, and the eastern highlands of Bombay Presidency (Poona, 28·3) have a rainfall between 10 and 30 or even 40 inches (Thurston, Douie, Kendrew). The Madras Presidency receives 10 to 30 inches per year in its southern portion, where *O. dillenii* is very prevalent, while the remainder of it averages between 30 and 50 inches, as do also most of Mysore, Hyderabad, Deccan, and Berar. The monthly distribution of this rainfall, at a number of selected places, including the localities just mentioned, is given by Kendrew (p. 193). Bengal, Bihar, and Orissa, which are outside the region where pest prickly pears are prevalent, have a high annual rainfall, being 50 to 100, 50 and 58 inches respectively (O'Malley), while the coastal strip of the Bombay Presidency receives 120 inches per year. The Indian rain is almost entirely received in the monsoon period, between June and October, very little falling during the very hot season, March to May, and least during the relatively cold season, January and February.

Northern Ceylon has abundant pear *(O. dillenii),* and this region is the driest in the island, receiving its rain chiefly from October to December, while the other portions obtain their rainfall during either the north-east monsoon, January to March, or that of the south-east (June to September).

The isotherms for January and July, and the mean annual isotherms for northern Ceylon are, respectively, 77·5°-80°, 85°, 82·5° F.; for southern India (Madras Presidency), 75°-77·5°, 85°, 82·5°; for central India and Deccan, 77·5°-80°, 82°-85°, 80°-85°; Lahore district, 55°-57·5°, 90°-92°, 77·5°; Delhi region, 60°-62°, 87°-90°, 77·5°-80°. The midwinter mean temperature of the

pear infested areas is thus at least 55°, the midsummer mean, not less than 80°, and the mean annual between 77° and 85° F.

South Africa.—Though *O. monacantha* occurs in Natal and near Cape Town, the real prickly pear region is in eastern Cape Colony, including the Graaff Reinet, Middelburg, Cradock, Somerset, Beaufort, and Bedford districts particularly, where certain Mexican species (*streptacantha* group) have monopolised the land, while further to the south, in the Humansdorp district, near Port Elizabeth, a Uruguayan species (*O. aurantiaca*) was locally prevalent. This pear zone lies especially in a region with a low average annual rainfall (10-30 inches, chiefly 15 to 20), and in the southern part of it (*e.g.*, Bedford) receives from 60 to 70 per cent. of it during the summer (October to March), while the northern portion (northward from Graaff Reinet and Cradock) obtains 70 per cent. to 75 per cent. during that period. Humansdorp is on the line of equal summer and winter components. Port Elizabeth receives between 50 per cent. and 60 per cent. of its total in winter, between April and September; Capetown (25 to 45 inches total), over 70 per cent. during winter; while Natal receives between 60 per cent. and 85 per cent. of its 30 to 50 inch total during summer, the percentage increasing with the distance from Durban (61 per cent. to 75 per cent.; Pietermaritzburg, 75 per cent. to 85 per cent.), and, in the Transvaal, it is 85 per cent. to 90 per cent., while in the northern Transvaal 95 per cent., or more, falls in the summer. The average annual rainfall of the chief infested localities and the percentage which falls during summer are now given: Alice, 22·8 (66 per cent.); Beaufort West, 9·46 (66); Cookhouse, 16·2 (71); Cradock, 15·2 (68); Fort Beaufort 21·65 (68); Graaff Reinet, 14·64 (66); Middleburg, 13·85 (72); Humansdorp, 26·88 (50); Hankey, 16·79 (53); Uitenhage, 18·25 (52). Other records of interest are Capetown (Platte Klip), 45·12 (24); Durban, 41·87 (71); Pietermaritzburg, 35·97 (82); Johannesburg, 29·03 (87); Pretoria, 29·80 (91); Bloemfontein, 22·05 (76).

The mean temperatures for January and July, as well as the average annual temperature of towns in the pear region in Cape Colony, fall between the following isopleths:—Graaff Reinet and Cradock, 82·5°-85° F., 60°-62·5°, 70°-72·5°; Bedford, 77·5°-80°, 60°-62-5°, 70°-72·5°; Humansdorp, 72·5°, 57·5°-60°, 62·5°-65°; Uitenhage, 75°, 57·5-°-60°, 62·5°-65°; [Capetown, 70°, 55°, 60°-62·5°]. The mean annual temperature of the true prickly pear zone in South Africa is thus between 62·5° and 72·5° (range, 57° to 85° F.). A Uruguayan species was rather widely distributed throughout the region, but occurred most commonly in a few localities in the southern part of it, *e.g.*, Uitenhage and Humansdorp.

This rather large invaded area is on sediments belonging to the Karoo system and lies chiefly in the vegetation zone labelled as thornveld, but a part has invaded the eastern portion of the Karoo. Humansdorp district lies in a rather small coastal forest belt. The Free State and Transvaal—"high veld"—have too high an altitude for vigorous prickly pear growth, while Natal has too great a rainfall, except for *O. monacantha* and allied species. The remainder of Cape Colony is either too dry or else receives too small an amount of summer rainfall to allow of extensive growth of Opuntias, though *O. monacantha* grows well as isolated plants or as clumps in many parts of South Africa from northern Transvaal (Pietersburg) to Capetown and Durban, but it is only in eastern Natal, with its subtropical climate, that the species has increased to such an extent as to require attention. South African experience in regard to this plant—a native of the moist tropical and subtropical parts of eastern South America—is very similar to that in Australia, since it was only in Queensland that it became a pest, though the species is to be found growing naturalised in several southern Australian

localities such as Perth, Adelaide, Melbourne, Sydney, occurring chiefly as an escape plant from gardens or hedges.

The Mediterranean Littoral.—It has already been mentioned that though Opuntias are very common in this region, the chief species, *O. ficus-indica* and *O. amyclea,* have not constituted themselves a nuisance, though they were widely distributed long ago, probably soon after the discovery of the New World. These are very much utilised by man for the sake of their edible fruit, and are perhaps to be regarded as more or less semicultivated, and either deliberately propagated or else allowed to propagate from fallen segments. If seed germination occurred to any appreciable extent, and conditions were favourable for the growth of seedlings, there would have been a very dense infestation by this time, but it has not occurred. *O. dillenii* is widely distributed around the shores, but it has not become a menace there as it has done in southern India and northern Ceylon. What are the factors which have limited growth in the Mediterranean? The outstanding fact in regard to its climate is its winter rainfall and very dry summer. The latter must play a very important part in preventing the germination of seed, the growth of seedlings, and the rapid growth of established plants.

Coastal Morocco, and the greater part of Algeria and Tunisia, have a rainfall between 10 and 20 inches, increasing along the Algerian coast (20 to 40 inches); Tripoli 16, Port Said 3, Alexandria 8, Cairo 1. This falls from October to March or April, especially in December, 80 per cent. of the Algerian rain being received during winter. The coasts of Asia Minor have an annual fall of 20-30 inches; those of Syria and Palestine 20 to 30, received almost entirely from November to March.

Southern Spain (Andalusia) receives 20 to 30 inches, but most of its Mediterranean coast obtains only 10 to 20 inches; Italy, 20 to 40; most of Sicily, 20 to 30; Greece resembles Sicily, but is rather drier. The wettest months are in early winter (December or November) in Morocco, Algeria, Tunisia, Syria, Palestine, Asia Minor (coast), southern Sicily; December and February in Syria and the Levant; and October in southern France and Spain, Italy, and the Balkan Peninsula. Rain falls most frequently, though not necessarily, in the greatest amount, from November to January, except in the Riviera and northern Italy, where it occurs in November and April, and least frequently in July or August. Data regarding mean monthly rainfalls at several typical towns, *e.g.,* Genoa, Palermo, Athens, Nice, and Seville indicate that in the Mediterranean portion of Europe most rain falls during autumn and spring in its northern section, and during the winter in its southern portion, as well as along the northern African coast.

The average temperature for the southern Mediterranean littoral and the Levant, during January, lies between the isotherms 50° and 60° F., while most of the European portion lies between 40° and 50° F. In July it all lies between the isotherms of 70° and 80°, while its mean annual temperature lies between 60° and 70° F. We note, then, that the midwinter mean is well below that of the pear region in Australia, though the midsummer mean, as well as the mean annual temperature, agree fairly well. Except for its decidedly colder winter, its temperature conditions resemble those of the pear area of eastern Cape Colony. The amount of rainfall in the greater part of the Mediterranean littoral (except Tripoli, Egypt, and part of Tunisia) would be quite sufficient to allow Opuntias to become a pest if it were received mainly during summer.

We may now briefly review the evidence offered in the preceding statement of the climatological data belonging to (1) the main cactus zone in America; (2) the regions of the world (other than Australia) where prickly pears have become naturalised and have come to constitute a pest; (3) the region where they have

long been naturalised and have not become a true pest; and, lastly, (4) the Australian region.

Practically all pear countries, apart from littoral regions, are in a mixture of grassland and open forest or shrubland, or in the latter. Altitude apparently plays a part insofar as it affects temperature and rainfall, so that a knowledge of the two latter factors need only be taken into account.

The great Opuntia zone of Mexico and the adjacent region of the United States, America, have an average annual rainfall of between 10 and 30 or 35 inches, especially between 15 or 20 and 30 inches, with a marked summer maximum, though, in most places, there are winter falls also. Its annual average temperature is about 70° F. (65°-70°), with midwinter and summer means of 55-60° and 80° respectively. A similar set of climatic conditions has been shown to occur in the chief Opuntia regions of South America. In America the area is bounded approximately by 30° N. (San Antonio, Texas—a homoclime of the Hunter-Goulburn valley prickly pear area in N.S. Wales), and by 35° S. (Montevideo, Bahia Blanca), where the pronounced summer character of the rainfall becomes lost and a more or less uniform distribution is experienced—in other words, the northern and southern limits in the New World are similar climatically to the present southern limit of the prickly pear in Australia.

In South Africa, the infected territory lies in a region with an average rainfall between 10 and 30 inches annually (chiefly 15 to 20), which is limited, southerly, by an area receiving uniform or chiefly winter rainfall; and, northerly, by an area whose annual supply is very low. The mean annual isotherms of the area are 62·5° to 72·5° F., with an average annual range from 57° to 85° F.

In India the region has a rainfall between 10 and 30 inches (pear being chiefly in the portion with a fall between 20 and 30 inches), increasing along the affected coastal zone. This rain is also received during summer. The mean annual isotherms of the vast area —northern Ceylon to Punjab—are between 77° and 85° F., ranging from 55° (midwinter) to 90° (midsummer mean), the variation being greatest in the Punjab.

The Mediterranean littoral has most of its prickly pear in lands receiving 20 to 30 inches of rain annually, but very little of it during summer. The mean annual isotherms are 60° to 70° F., with mean midwinter and midsummer ranges 40° to 60° and 70° to 80° F., respectively. The mean annual and winter temperatures of the northern coasts are considerably below those of any of the other prickly pear regions, including eastern Australia, and moreover, the winter character of the rainfall is another distinguishing feature.

Probable Future Extension of Prickly Pear in Australia.

We are now in a position to indicate in which direction the advance of the pest in Australia is likely to take place. Species like *O. amyclea* and its relatives may be able to obtain a footing in southern Australia with its Mediterranean climate, but would not constitute a pest, since the abundance of other and more palatable fruit would not lead to widespread utilisation and distribution of such cacti. *O. monacantha* would become a nuisance only in those parts which have a tropical or subtropical climate with a heavy rainfall received largely in the summer, but also a considerable amount distributed throughout the rest of the year; in other words, the conditions that favour a "rain forest" are highly suitable for this species. *O. aurantiaca,* a native of the south-eastern part of the South American pear region, has become acclimatised in the southern portion of the pear region of South Africa and Australia (Darling Downs and Hunter valley) and may be expected to continue to spread in those regions, but will probably not extend northward much beyond its present range. *O. microdasys* from the dry north-central Mexican plateau would probably continue to thrive northwards

from the Pilliga, invading the western portion of the Darling Downs and adjacent plains. Its native habitat has a rainfall between 10 and 20 inches annually, received largely during three months in late summer and early autumn, so that the species would probably thrive in the extensive zone west of the Upper Darling and Warrego in New South Wales and Queensland, respectively, where a similar climate occurs. Of all the Opuntias naturalised in the Commonwealth, this species and *O. imbricata* (from the northern Mexican and Arizona highlands) are the two which would be most likely to spread in the region having a rainfall between 10 and 20 inches received very largely, but not entirely, during summer. A line drawn from Warren through Brewarrina and extending into Queensland, to the west of Cunnamulla, may be taken as a probable southerly and westerly limit for them. They are not likely to become a pest in regions receiving a good rainfall.

O. tomentosa, from the warm parts of southern Mexico, will probably restrict itself to the more northerly portions of our area and show a preference for the coastal region having a rainfall between 30 and 40 inches. There is a long comparatively narrow region a short distance inward from the Queensland coast, and roughly parallel to it, which would suit the species. Both *O. tomentosa* and *O. monacantha* might prove troublesome if they reached the Atherton tableland. *O. megacantha* is now growing in a climate resembling that of its native habitat, and though at present restricted, is capable of considerably widening its range in Queensland and New South Wales. The two species of *Nopalea* are of little importance and not likely to constitute a pest. *O. robusta* would spread in Queensland and northern New South Wales if given the opportunity. Both *O. dillenii* and *O. elatior* are potential pest species, the former being the more dangerous, as it has occupied large areas in the drier and coastal parts of India and Ceylon. It could establish itself practically anywhere around the whole of the Australian coast, as it has done along many tropical shores and on the Mediterranean littoral, but would not become a menace except under climatic and other conditions such as favour the common pest pear, *O. inermis.* This is probably true of *O. elatior* also, which is not, however, a maritime species.

The writer cannot offer any satisfactory reason why *O. maideni* should be so abundant in the Burnett valley and in parts of the Fitzroy valley, while *O. inermis* should be relatively uncommon there. Perhaps the "spiny pear" may have been introduced into that part of Australia, in the first place (just as *O. megacantha* was), and thus obtained a firm footing before the pest pear reached those districts. It seems to prefer a warmer climate than the pest pear, but as the two thrive side by side in the region referred to, it may be assumed that *O. Maideni,* like *O. dillenii,* would be likely to extend into regions which are suitable for *O. inermis.*

Ignoring the question of soil and basing an opinion on climatological evidence, the writer believes that the pest pear *O. inermis,* if left unchecked by biological, chemical, mechanical, or administrative agencies, will be able to extend its range very widely, but only in certain directions. Conditions which favour the formation of a pure savannah appear to be unfavourable for prickly pear. *It will not become a pest south of the line of uniform rainfall; nor in the region where there is a pronounced dry season of five or more months; nor in those parts receiving an average annual rainfall greater than 32 (perhaps 35) inches; nor in the New England tableland and its extensions, on account of the altitude together with the higher rainfall and colder winter. The region south of a line from Sydney to Bourke is not likely to become infested, so that southern and western New South Wales, Victoria, South Australia, and south-west Australia will be outside its future range.* There are no climatological grounds for believing that the Hunter area will not extend westerly to fuse with the area

lying north of Dubbo, and the latter is now joining up with the Pilliga area. The latter may slowly extend eastwards up the Naomi watershed to include the Liverpool plains ultimately, but would extend more rapidly westwards, *i.e.*, down stream. The remaining areas in New South Wales may all become continuous, particularly if heavy floods occur. There may be a slight easterly extension of the northern infested area to form a tongue-like intrusion between Inverell and Bundarra.

It seems probable that if the pear be permitted to spread naturally, its southern limit would remain practically in its present position. It would be bounded by the southern boundary of the Hunter-Goulburn valley (*i.e.*, the Hunter Range) and by a line from its western extremity, passing just north of Gulgong (near Mudgee), Dubbo, Narromine, and Trangie, and probably along the Macquarie River to the Barwon. There might, perhaps, be an extension down the latter river, but it would be held in check by the comparatively low annual rainfall and the high evaporation rate. From the vicinity of the Macquarie-Barwon junction the line may be drawn northward into Queensland, to a point west of Bollon; thence to a point about midway between Wyandra and Charleville; thence north-westerly to the east of Adavale; thence northerly just to the west of Isisford (19·20 inches average annual rainfall), Aramac (18·14), Longreach (17·16), and Muttaburra (18·16), curving north-easterly towards Charters Towers (25·52) and Ravenswood (28·69); thence south-easterly to Nebo (Fort Cooper) and along the range forming the eastern boundary of the Isaacs watershed, and down the Fitzroy valley; from the vicinity of Stanwell or Westwood southwards to the eastern limit of the Dawson valley, extending into the Upper Burnett valley, where the rainfall does not exceed 30 to 32 inches; thence along the Main Range to the New South Wales border, with an incursion into the Brisbane valley, chiefly to the south of the Ipswich-Toowoomba railway line; thence west of the Main Range from the vicinity of Dalveen and following approximately the 2,000 feet contour into New South Wales to the west of Emmaville, Inverell, Tingha, Bundarra, and Barraba, and around the Nandewar Range; thence easterly to the east of Tamworth and Quirindi; westerly around the Warrumbungle Range to Coonabarabran and curving towards Cassilis and Murrurundi; thence along the 2,000 feet contour of the Mount Royal Range to its southern extremity not far from Singleton and Maitland.

The most rapid extension of the area will probably be downstream due to flood waters distributing detached segments, but wide distribution, though at first not so obvious, will probably be effected through birds depositing seeds which pass unharmed through their digestive tract, and are capable of germinating after the summer rains have commenced.

The pest pear would probably thrive at Ravenswood, in North Queensland, but not so well at Charters Towers, and will probably never become a pest in the region lying west of Isisford, Longreach, and Muttaburra, where the rainfall is comparatively light and is of a very pronounced summer type—*e.g.*, Winton, with 15·28 inches average annual rainfall, but with an average of seven successive months each with less than an inch of rain; Ayrshire Downs (16·48), with a similar distribution; Hughenden (19·66), with six consecutive months averaging less than an inch each. Climatically, the districts around Augathella (22·83), Tambo (22·30), Barcaldine (21·67), and Alpha (23·30), all free from pear as yet, are suitable for its active growth. The pest is not likely to extend eastwardly much beyond its present limits in the north, as the pear in the Nebo district (31·96) is only a few miles west of Wandoo Station, which receives 40·81 inches, while to the south of this locality as far as the Hunter River in New South Wales we may reasonably assume that the 32-inch isohyet will mark its

eastern limit as a pest. Great extension to the west of this region is quite possible, so that there may eventually be a very large infested area north of the central western railway line in Queensland. The northernmost area is now becoming fused with the pear region which extends from Stanwell or Westwood to Emerald. Northern and north-western Australia receive a rainfall whose character and amount are not likely to favour the spread of prickly pear, except *O. monacantha* in the wetter regions receiving well-distributed rain, and *O. dillenii* in the drier and coastal zones, where the rainfall is from 20 to 30 inches annually.

A climatological study of the Opuntia regions of the world leads to the conclusion that, if soil conditions be suitable, the pest pear O. inermis will be capable of extending very considerably in eastern Australia, especially in Queensland, so that the total invaded area may be nearly three times the area now invaded; while the rest of Australia presents conditions which do not favour the spread of such cacti.

LITERATURE.

Britton, N. L., and Rose, J. N.

1919—The Cactaceae, vol. i., Carnegie Inst., Washington.

Burkill, I. H.

1911—Rec. Bot. Survey, India, 4 (6), pp. 287-322.

Coulter, J. M.

1896—Contrib. U.S. Nat. Mus., 3, pp. 355-462.

Douie, J.

1916—The Punjab, North-west Frontier Province, etc., Cambr. Univ. Press.

Griffiths, D.

1905—Bull. 74, Bur. Plant Ind., U.S.D.A.
1908—Bull. 124, Bur. Plant Ind., U.S.D.A.
1909—Bull. 140, Bur. Plant Ind., U.S.D.A.
1912—Farmers' Bull. 483, U.S.D.A.
1913—Bull. 31, U.S.D.A.

Griffiths, D., and Hare, R. F.

1906—Bull. 60, Agr. Exp. Sta., New Mexico.
1907—Bull. 102, Bur. Plant Ind., U.S.D.A.

Hunt, H. A.

1914—Results of Rainfall Observations made in Queensland to 1913. Melbourne, 1914.

1916—Results of Rainfall Observations made in New South Wales during 1909-1914. Melbourne, 1916.

Johnston, T. H.

1922—Agric. Jour. Queensland, May, 1922, pp. 238-240.
1923—Rep. Austr. Assoc. Adv. Sci., 16, pp. 347-401.

Johnston, T. H., and Tryon, H.

1914—Report of the Prickly Pear Travelling Commission. Parliamentary Paper, Brisbane.

Kendrew, W. G.

1922—The Climates of the Continents. Clarendon Press.

Maiden, J. H.

1898-1917—Numerous articles on Prickly Pear in Agric. Gaz. N.S. Wales, 1898-1917.

1908—Trans. Roy. Soc. S. Austr., 32, 1908, pp. 252-286.

O'Malley, L. S.—
1917—Bengal, Bihar, and Orissa. Cambr. Press.

Small, J. K.
1919—Jour. New York Bot. Garden, 20, pp. 21-39.

Taylor, G.
1918—The Australian Environment, etc. Melbourne.
1923—Rep. Austr. Assoc. Adv. Sci., 16, pp. 433-487.

Thornber, J. J.
1910—Bull. 65, Univ. Arizona Agr. Exp. Sta., pp. 245-360.
1911—Bull. 67, Univ. Arizona Agr. Exp. Sta., pp. 457-508.

Thurston, E.
1913—The Madras Presidency, etc. Cambr. Press.

Wooton, E. C.
1911—Bull. 78, Agr. Exp. Sta., New Mexico.

1922-3—Official Year Books of South Africa, 5, 1922 (1923); 6, 1923 (1924).

1923—Report of Royal Commission to inquire into certain matters relating to the Prickly Pear Problem. Parliamentary Paper, Brisbane.

DESCRIPTION OF PLATE XXV.

Photographs of *O. maideni* (from Degilbo, Burnett River) showing habit of the species. The right-hand plant was grown under shade conditions, hence the lack of spines. Scale in inches. (Photograph by H. W. Mobsby.)

FURTHER DISCOVERIES OF PERMO-CARBONIFEROUS GLACIAL FEATURES NEAR HALLETT'S COVE.

By Professor Walter Howchin, F.G.S.

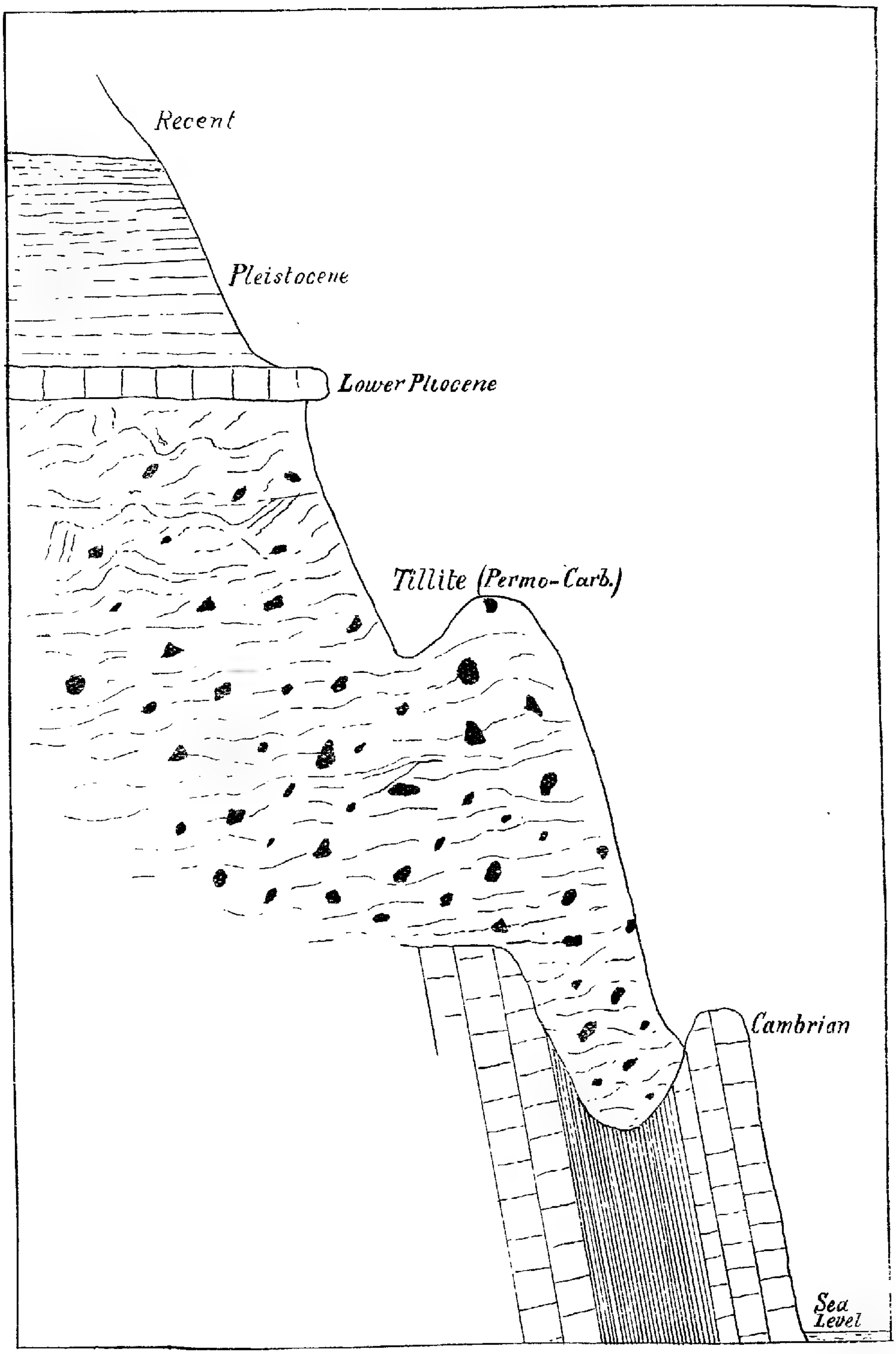
[Read October 9, 1924.]

Plates XXVI. to XXVIII.

The remarkable features that distinguish Hallett's Cove as one of the most picturesque and interesting localities on the coast have concentrated attention on the broken ground of the amphitheatre and the historic polished surface of purple slate discovered by the late Professor Tate. It had long been taken for granted that the indications of ice action came to an end on the northern side of the outlet of the small creek that reaches the coast a quarter of a mile to the northward of Black Point. A recent examination of the ground has proved that this is not the case. Exposures of the tillite and very fine examples of polished and striated surfaces that formed the bed of the glacier can be traced along the top of the cliffs, more or less continuously for another half a mile. The polished surfaces, in this direction, differ entirely from those found near Black Point. In the latter case the floor over which the ice moved consisted of purple slates which, although easily scratched and furrowed, weather rapidly on exposure and the glaciated surfaces are soon obliterated by a process of exfoliation and flaking; but northward of the small creek just mentioned, the ice moved over a floor of quartzite on which the ice-marks have a better chance of being retained.

From Black Point, northwards, a well-defined anticline occurs in the Cambrian Series having its axis situated a little inward from the coast with its western limb dipping steeply to the westward in the sea cliffs. At Black Point the cliffs consist of very dark-coloured purple slates, but nearer the axis of the anticline the fold includes some hard siliceous quartzites. The general strike of these beds is a little more westerly than the alignment of the coast, so that the beds gradually run out on the cliff face and beds nearer the axis of the fold take their place in succession. In accordance with this stratigraphical feature the purple slates of Black Point run out to the seaward, at about the intersection of the first creek northward of Black Point, and are replaced by quartzites separated by layers of purple slates. This gives rise to an unstable condition in the rock structure when exposed to wave action, so that the line of cliffs along the stretch of coast, dealt with in the present paper, is repeatedly broken. The hard layers of rock form angles by the retreat of the cliff on the northward side, the following softer bed yielding and the next underlying hard bed forms the cliff, until it also is truncated, in its turn, with another set back of the cliff to the northward. In this way the sea cliffs exhibit a succession of rock faces at right angles to the coast, occasioned by the retreat of the adjacent cliff, having some resemblance to the teeth of a saw. By this form of cliff-structure the hard members of the series form the edge of the cliffs in a zig-zag fashion, and it is these hard outcrops that carry the polished and striated features which indicate the path of the glacier.

The change in the nature of the sea cliffs, from purple slates to that of a close-grained quartzite, begins on the northern bank of the creek mentioned above. The rock is here slightly glaciated, as had been previously noted, but only for a few yards, and then the glacial striae appear to be cut off in a direction



Geological Section seen in sea cliffs near Hallett's Cove.

seawards, from which point the quartzite rock is much broken and sinks down to a small gutter which breaks the continuity of the cliffs, at about 40 yards northward of the creek mentioned. No glacial features were supposed to exist beyond this point.

The tillite is well exposed in the small gutter, just referred to, and on its northern side is a large tabular-shaped erratic of Tapley's Hill ribbon slate measuring 4 feet by 4 feet, wedged in at the very edge of the cliff.

At a further distance of 55 yards, near the next prominent angle in the cliffs, is a round boulder of gritty limestone, measuring 2 feet 6 inches, derived from a characteristic bed of the Cambrian Series, above the Brighton limestone horizon. Near the same spot a small erratic of the ilmenite grits, derived from the basal beds of the Adelaide Series, was noticed.

Some 40 yards further to the northward, the quartzite, forming the top of the cliffs, is glaciated and continues to show such features for a considerable distance.

At about 150 yards from our starting point there occurs the most complete section of the tillite with its associated rocks contained within the limits of the Hallett's Cove outlier, and, probably, so far as the State is concerned (see text fig. and pl. xxvi.). The beds included in the section belong to five distinct geological ages, as follow, beginning with the oldest:—

1. The bed rock is of Cambrian age forming part of the Purple Slates Series. It consists mainly of quartzites that form the sea cliff having a steep dip to the westward. Height above sea level .. .. 40 feet

2. Resting on a Cambrian floor is the tillite, or boulder clay, which has the character of an argillo-arenacious deposit, varying in colour as yellowish, bluish, or of purple-like tint; finely laminated, sometimes passing into a clayey sandstone. The bed, in places, has undergone considerable contemporaneous contortions. This can be best seen near its upper limits, where the purple-coloured layers, or streaks, are pushed up into folds, and even forced, in blocks, into a perpendicular position. The uppermost 9 feet of the tillite partakes of the nature of a yellowish clayey-sand, penetrated by thin streaks of purple-coloured clay that occur at various angles. Estimated thickness 65 feet

3. Resting directly on the tillite is a strong bed of fossiliferous, gritty sandstone, of Lower Pliocene age. The fossils, which are present in great numbers, are mostly in the form of impressions and casts. The large foraminifer, *Orbitolites complanata*, is very common. Thirteen examples of this form were counted on a single slab, varying in size up to an inch in diameter. Thickness of bed .. .. 3 feet

4. The newer formations, in ascending order, are Pleistocene mottled sandy-clays, grits, and gravel (20 feet) overlaid by Recent reddish clays, travertine, and blown sand that form a grassy slope. Estimated thickness 50 feet

The tillite in the above section is partly obscured by large blocks of the fossiliferous sandstone which have slid down from their proper position and, also, by blown sand from above.

On the northward side of the section, just described, there is an angle in the cliffs with a way down to the rocks below. This break in the cliffs is connected with a deep ditch that has been excavated by the glacier and is now filled with boulder clay. The overdeepening that took place at this spot arose from the presence of a stratum of purple slates, about 12 feet in thickness, in the bed rock, which yielded more readily to the erosive action of the glacier than the quartzites on either side. The respective walls are glaciated. Some small rivulets have washed the boulder clay from the face of the purple slates exposing two glaciated faces with a western aspect, measuring, respectively, about 4 square feet and 8 square feet. About half-way down to the rocks, on the beach, is an erratic of dark-coloured felspar porphyry, about 14 inches in length; and, at a lower level, within tide limits, is a granite erratic of the Victor Harbour type, coarse-grained, pinkish, with porphyritic inclusions of felspar crystals, 2 inches in

diameter. The boulder measures 3 feet 4 inches by 2 feet. At a higher level, on the face of the tillite, is a group of erratics obtained from the Sturtian tillite, five or six in number, the largest of which measures 3 feet 6 inches in length.

About 70 yards further to the northward the sea cliffs are once more broken and set back a few yards. Some of the most interesting features of the locality occur at this point. The glacially eroded ditch, mentioned above, is more clearly defined at this spot. So far as the present features are concerned the ditch has very unequal sides. The western wall is formed by what is left of the outer cliff which is heavily glaciated from the top to the bottom of the hollow, a depth of about 12 feet. In its upper portion, the quartzite, in a polished face 10 feet in length, is very strongly striated and grooved (see pl. xxvii., fig. 1). Unfortunately a portion of this very fine glaciated surface has been overgrown by lichens, which have not only obscured the glacial features beneath, but, by their disintegrating action, have obliterated them. The eastern wall of the ditch is about 25 feet in height, the upper portion of which is bared to a depth of 9 feet, the surface of which is glaciated.

Twelve yards further to the northward there is still another break in the cliffs with a truncation of the outer cliff and formation of another by retreat. Here, again, are seen the two opposing glaciated faces, the one facing west and the other facing east. At a low level the purple slates are visible, showing polished surfaces, and at a higher level the quartzites are glaciated over an extensive surface (see pl. xxvii., fig. 2). The junction between the polished surface and the unglaciated portion, in a straight line, is very clearly defined. It was on the landward side of this spot that the photograph of the tillite (pl. xxviii., fig. 1) was taken.

Travelling northward, along the quartzite outcrop, the rock surfaces are polished and, practically, continuously so for a distance of 90 yards. Then, for about an equal distance, the surface of the cliff is more or less broken and the glacial features are indistinct.

About the position indicated in the last paragraph a very large erratic occurs on the top of the cliffs, not many yards from their edge. It is an impure, earthy limestone, that measures 8 feet 6 inches in length, 6 feet 6 inches in breadth, and is 3 feet 4 inches in height (pl. xxviii., fig. 2). It was derived from the Impure Limestone Series that underlies the Brighton main limestone.

At a distance of 35 yards from the erratic, just described, the most important break in the cliffs, within the area under description, occurs. The cliffs, here, retreat for a distance of 20 yards, on a sharp angle, and have a height of 30 feet above those immediately to the southward. The truncated portion of the outer cliff is glaciated, but no evidence could be found of any ice marks on the higher cliffs, either on the cliff edge or of boulder clay to the landward.

Broken, rocky ground continues for 200 yards, when the land slopes down to a small creek that has formed a succession of waterfalls in cutting its way through the hard rocks to the beach. The quartzite, that forms the termination of the cliffs on the southern side of this creek, is glaciated with a small amount of tillite banked against it. These were the last vestiges of the path of the glacier noticed in that direction, the quartzite quickly gives place to soft purple slates which fail to retain ice marks for any length of time.

The Tillite.

The tillite forms a continuous deposit from Black Point to the large erratic shown on pl. xxviii., fig. 2). It forms the lower slopes of the secondary cliffs that rest upon the peneplained Cambrian rocks, but the face of the tillite is largely obscured by more recent clays and blown sand carried down from higher levels.

Surface wash and small rain gutters have removed the covering, in places, so that the tillite can be easily followed.

In composition and structure the tillite is a finely laminated argillaceous deposit, mostly a greyish and bluish soft shale in its lower portions, with more or less purple-coloured layers and bands, especially in the upper parts. Bands of a sandy nature occur at intervals and are usually of a yellowish colour. It has undergone contemporaneous contortion at some horizons, which is especially noticeable near its upper limits. This feature may be associated with the retreat of the ice which may have been subjected to seasonal retreats and advances. A typical illustration of the boulder clay is reproduced in pl. xxviii., fig. 1.

The Erratics.

The tillite is not particularly either stony or gritty in its composition as a whole. Considerable portions seem almost destitute of stones, while, in other places, erratics are common. A classification of the erratics brings out some interesting particulars. They may be roughly placed in two sections with respect to their origin.

1. *Erratics that are far-travelled.* These include granites of various types, some fine-grained, but the greater number are coarsely crystalline with large felspar inclusions showing a close resemblance to the porphyritic granite of Western Island, near Victor Harbour. A few examples of a dark-coloured felspar porphyry were noted, and a large block of white quartz-rock, 28 inches in length, occurs, forming a conspicuous object on a grassy slope of the secondary cliff.

2. *Erratics that have had a more local origin.* These comprise, by far, the greater number of those present in the tillite, and include examples quarried from the principal outcrops of the Adelaide Series. A typical example of the ilmenite grits, that form the base of that series, was observed. Several large blocks of quartzite of the Glen Osmond and Mitcham type occur. One of these, situated on the same knoll as the white quartz-rock, mentioned above, measures 4 feet 6 inches by 3 feet, which is used by the sheep as a shelter and as a scratching stone. One example of the Sturtian tillite was observed at the southern end of the line of cliffs and a group of five, as described above. The Tapley's Hill ribbon-slate is moderately common, but easily splits up on the cleavage planes, showing that this structural feature of the rock antedates that of the Permo-Carboniferous Period—an example seen was glacially smoothed and striated. Some large blocks of the siliceous and slaty limestones belonging to the lower members of the Brighton Series occur, one of which is shown on pl. xxviii., fig. 2. It is the largest erratic seen on this part of the coast, and, like the larger quartzite, mentioned above, forms a shelter for the sheep. Quartzites of a purplish colour found in the tillite must have been ploughed up from the immediate bed rock on which the tillite rests. The local purple slates were too soft to form distinct erratics, but have been ground down to form a very large proportion of the argillaceous material that makes up the greater part of the tillite. Dark-coloured shales or slates make up a considerable proportion of the erratics which have probably been derived from the beds of the Adelaide Series, but are not sufficiently characteristic to be referred to their respective horizons.

These locally derived erratics indicate that the ice must have travelled from a S.S.E. direction, crossing the country through which the Onkaparinga and Field Rivers now flow. It is worthy of note that no true limestones have been recognised among the erratics. The Brighton limestone, over which the glacier must have passed, makes only a small feature in the outcrops, so that the absence

of erratics obtained from the horizon need not cause surprise, but the Archaeocyathinae and associated limestones, of the Willunga ranges, are of much greater extent, and if at the surface at this period of glaciation should have yielded their quota in the transported material. Their absence from the tillite can, however, be easily accounted for. The limestones referred to have been brought to the surface by the block-faulting of the Mount Lofty and associated ranges. The downthrow of the Mount Lofty block and the upcast of the Willunga ranges have exposed these beds along the fault scarp, a geological event that is of, comparatively, recent date, so that at the time of South Australia's ice-age these beds were deep-seated and far beyond the erosive action of the ice.

DESCRIPTION OF PLATES XXVI. TO XXVIII.

Plate XXVI.

A face of Tillite capped by a bed of fossiliferous Pliocene. The photograph takes in about one-third of the glacial beds included in the section. The large stones seen in the picture have fallen down on the face from the Pliocene cap.

Plate XXVII.

Fig. 1. Glaciated Quartzite, 10 feet in horizontal length. Forms a part of the western side of the glacial ditch. The upper part is obscured by algae growths. The black vertical and horizontal portions are cracks and cavities in very dark shadow.

Fig. 2. Glaciated Quartzite on eastern side of glacial ditch. Note the sharp line of distinction between the glaciated upper surface and the rough face where the rock has been fractured.

Plate XXVIII.

Fig. 1. An exposure of Tillite under weathering. Two granite boulders are seen near the centre.

[As proof of the rapid change of features on this face (which is rather steep and near the edge of the cliffs), on visiting the spot a few weeks after the photograph had been taken one of these granite boulders was missing. In another visit, a week or two later, the second granite boulder was gone. Wind and rain-wash had carried them over the cliffs and they are now at the base of the latter.]

Fig. 2. An Erratic of shaly Limestone (end view) measuring 8 feet 6 inches by 6 feet 0 inches, by 3 feet 4 inches high.

[All photographs are by the author.]

ANTHROPOMETRIC AND DESCRIPTIVE OBSERVATIONS ON SOME SOUTH AUSTRALIAN ABORIGINALS, WITH A SUMMARY OF PREVIOUSLY RECORDED ANTHROPOMETRIC DATA.

By F. Wood Jones, D.Sc., and T. D. Campbell, D.D.Sc.

[Read October 9, 1924.]

Plates XXIX. and XXX.

No apology is needed for recording in a short paper the complete measurements of only a few individuals, when these individuals belong to the most rapidly vanishing section of a dying race. The task of securing full anthropometrical data is becoming progressively more difficult as time goes on, and, unfortunately, we are already too late to embark on any satisfactory study of the natives of the southern portions of this State.

Only ten individuals have been passed in review for the purpose of this paper; nevertheless, though the number of subjects is small the range of observations and measurements is fairly comprehensive, and it cannot be said that these observations are in any way redundant in view of the very scanty literature dealing with the anthropometry of the Australian Aboriginal.

The first eight subjects were measured and examined by the authors during a trip made to the Stuart Ranges in 1923. These eight subjects were members of the Kookata tribe—a tribe that will before long cease to exist in its pure blood. Of the eight Kookata five are males and three females, and since the observations were made one of the males, the then recognised head of the tribe, has died. The remaining two subjects, a male and female, were measured and examined in Adelaide, whither they had been brought as witnesses under police escort, from Streaky Bay in 1923. For kind permission to conduct this examination we are indebted to the police authorities, from whom we received every assistance. In the case of the Kookata natives we are under a special debt to the Messrs. Jacob Brothers, on whose head station at Mount Eba the examination was conducted.

Instruments employed.—In all cases Professor Rudolph Martin's stature rod, spreading calipers and sliding compasses—made by P. Hermann, of Zurich—were used. In addition, a millimetre, non-metallic, measuring tape was employed in certain measurements. The whole examination was conducted strictly under field conditions, the subjects being studied and examined in the open whenever and wherever opportunity could be found. The photographs, also, were necessarily field snapshots rather than studio studies of the subjects.

Measurements recorded.—The records taken represent an eclectic series culled from the full set suggested by the Monaco Conference (1906), and for the purpose of the present enquiry the works of Ales Hrdlicka, H. H. Wilder, and L. R. Sullivan have been taken as guides. All the observations recorded are of importance, but the experience of the present authors has convinced them that some of these measurements, when obtained under anything less than ideal conditions, are liable to a considerable degree of error. In certain cases nothing short of a prolonged and intimate overhaul of the completely nude subject can

accurately determine the exact measuring points. In the conditions under which field work among partly civilised and abundantly clothed natives has to be undertaken some uncertainty must attach to the identification of certain of the bony landmarks necessary for complete anthropometric work. It must be remembered that measurements have to be made under these conditions or they will not be made at all. We may have to contend against the embarrassment of a multitude of petticoats and trousers at the present day, but unless we are prepared to do this we must be content to watch with folded hands several tribes pass unmeasured and unrecorded into oblivion. Again, as every surgeon knows, obesity, a common condition of "station blacks," renders the isolation of bony measuring points a matter of some uncertainty. Nevertheless, despite the drawbacks of ample clothing and occasional obesity, we feel that the measurements recorded in our little series are as accurate as patience, some little experience, and the possession of good instruments can render them. For the use of the instruments we are indebted to the Board of Governors of the Museum, etc.

Subjects examined.—The individuals examined have, unfortunately, to be designated by white man's or station names, the native names not being obtainable. The following is a list of the individuals examined; they are distinguished by a letter by which they are designated in the table of measurements. The first eight individuals (A—H) are Kookata measured at Mount Eba; the remaining two (I and J) are Ngunga, from Streaky Bay:—

A. Yungun.
B. George Mitchell (then recognised head of the Kookata, now deceased).
C. Sugar Billy, from the west of the Kookata region.
D. Long Fred, son of C.
E. Dorothy, daughter of C.
F. Jinny.
G. Charlie.
H. Edie, from Tarcoola.
I. Annie Wombat, } Wife and Husband.
J. Dick Wombat, }

Anthropological Obsrvations recorded.—In addition to the measurements, a series of notes was made on each subject examined. These notes include the following details:—Colour of skin, eyes, and hair; hirsuteness of face and body and characters of the scalp hair; the condition of the teeth, and the presence, site, and type of cheloid scars.

In the case of colour descriptions we were handicapped by lack of standard colour guides; but as far as possible we have recorded our observations in accordance with the suggestions of Hrdlicka. Samples of hair were taken for histological examination and finger prints were recorded. Photographs, full face and profile, were taken of each subject. The ages recorded are necessarily only approximate.

TABLE I.

No.	Sex	Age	Skin colour	Eye colour	Hair colour	Hirsuteness			Head hair	Teeth	Cheloide scars	Remarks
						Face	Chest	Forearm				
A	Male	40	Dark chocolate	Dark brown	Black	Whiskers and moustache	Marked	Marked	Low waves	All good	Hip	
B	Male	60+	Dark chocolate	Dark brown	Black	Whiskers and moustache	Marked	Marked	Almost straight on top terminating in ringlets	A number missing and carious	Chest	
C	Male	50+	Dark chocolate	Dark brown	Black	Whiskers and moustache	Marked	Scant	Low waves	Good	—	Hole in nasal septum
D	Male	25	Dark chocolate	Medium brown	Black	Whiskers and moustache	Medium	Medium	Fairly straight (had been cut)	Some carious	—	
E	Female	16-18	Dark chocolate	Medium brown	Black	Nil	Nil	Nil	Low waves	All good, M_3 unerupted	—	
F	Female	Aged	Dark chocolate	—	White	Nil	Nil	Nil	Very low waves	—	—	
G	Male	Aged	Very dark chocolate	Dark brown	White	Whiskers and moustache	Marked	Marked	Bald on top of head, otherwise low waves	Good, right upper central incisor removed	—	Tufts of black hair on ears 50 mm. long
H	Female	25-30	Medium chocolate	Dark brown	Black	Beard and moustache fairly marked for a female	-	—	Low waves	Good	—	
I	Female	19	Light chocolate	Dark brown	Black	Nil	—	—	Wavy with terminal spirals	All present	—	
J	Male	23	Medium chocolate	Dark brown	Black	(Shaves)	Scant	Scant	Low waves	Some carious	-	Lips not so everted as in I

Measurements recorded.—Thirty-five measurements were taken of each subject. In the table these measurements are numbered from 1-35, the actual measurements indicated by the numbers being as follows:—

Body	1. Stature.
	2. Shoulder height.
	3. Height to supra-sternal notch.
	4. Sitting height.
	5. Arm span.
	6. Breadth across shoulders.
Head	7. Length.
	8. Breadth.
	9. Height (auricular-bregmatic).
Face	10. Length (menton-nasion).
	11. Height (menton-crinion).
	12. Breadth (maximum bizygomatic).
	13. Diameter (minimum frontal).
	14. Diameter (bigonial).
	15. Maximum interorbital.
	16. Maximum intercanthal.
	17. Minimum intercanthal.
	18. Bi-orbito-nasal arc.
Nose	19. Height.
	20. Breadth
	21. Length.
Mouth ..	22. Breadth.
Ear	23. Length.
	24. Breadth.
Upper Limb ..	25. Total length (with hand).
	26. Length upper arm.
	27. Length forearm.
Hand	28. Length.
	29. Breadth.
Lower Limb ..	30. Total length (to sole).
	31. Length (without foot).
	32. Length of thigh.
	33. Length of leg.
Foot	34. Length.
	35. Breadth.

All measurements are recorded in millimetres.

Note on nose measurements.—In reviewing the literature of anthropometry it becomes evident that some confusion exists as to the terms "nasal length" and "nasal height." In the present paper the authors have used the term nasal height for the measurement from the nasion (n) to the subnasale (s), and nasal length for that from the nasion to the point of the nose, pronasale (prn). By this usage, which is advocated by the British Association Anthropological Committee (1909), the terms are kept distinct. In accordance with this usage, the figures given by Spencer and Gillen and Stirling as representing "nose length" have been placed in our comparative tables under nasal height, in order to obtain uniformity. The full table of measurements is as follows, the individuals being represented by the letters A—J and the measurements by the numerals 1-35:—

TABLE II.

Subjects.

Observation	A	B	C	D	E	F	G	H	I	J	Max.	Min.
1	1660	1675	1595	1787	1616	1481	1580	1596	1480	1616	1787	1480
2	1390	1435	1358	1544	1372	1260	1336	1374	1240	1368	1544	1240
3	1370	1400	1312	1512	1391	1223	1302	1337	1210	1330	1512	1210
4	843	805	746	853	795	682	768	794	736	837	853	682
5	1705	1823	1705	1940	1684	1527	1630	1705	1475	1677	1940	1475
6									325	385	385	325
7	196	192	196	200	178	180	196	181	165	188	200	165
8	145	141	141	146	135	137	143	134	130	144	146	130
9	122	125	124	117	125	123	116	135	112	130	135	112
10	107	110	114	115	101	86	106	93	85	118	118	85
11	182	192	193	195	167	170		173	165	196	196	165
12	137	141	131	131	127	123	143	136	120	142	143	120
13	119	111	109	116	106	110	116	120	104	116	120	104
14	117	114	100	112	95	91	86	107	97	106	117	91
15	110	112	100	113	110	97	108	112	97	116	116	97
16	94	91	87	104	97	85	99	94	90	102	104	85
17	39	35	36	38	33	34	32	37	34	35	38	33
18	145	120	116	145	130	125	135	137	125	145	145	116
19	45	48	56	52	40	41	46	36	35	47	56	36
20	50	52	52	45	40	42	50	45	36	51	52	36
21	44	42	52	50	39	34	46	35	33	44	52	33
22	67	58	65	58	58	62	70	55	48	64	70	55
23	65	67	67	62	59	58	74	64	56	58	74	56
24	36	40	40	33	32	32	33	34	27	32	40	27
25	760	784	760	875	733	637	710	730	620	700	875	620
26	325	372	317	383	312	340	287	310	280	308	372	280
27	253	290	251	313	258	258	256	260	238	250	313	238
28	198	195	187	215	187	172	200	185	165	181	215	165
29	82	81	86	86	70	67	80	80	66	75	86	66
30	880	940	931	1022	940	885	873	980	922	925	1022	880
31	824	887	885	956	887	834	804	940	864	860	956	804
32	447	435	449	495	455	394	393	480	454	470	495	393
33	377	452	439	460	432	440	411	460	410	390	460	377
34	250	265	261	282	250	232	254	244	221	246	265	221
35	88	100	92	100	91	74	90	100	75	100	100	75

In order to render these figures more useful to students of physical anthropology, we have thought it best to draw upon the work of previous observers, and in this way to present a more complete picture of the numerical facts of the physical form of the Australian Aboriginal. Measurements that are presented in the form of isolated tables of figures are, of course, of vital importance, but they have not achieved their full utility when left in that form. For this reason we have, with permission where possible, extracted mean values and several indices from the measurements compiled by others, and presented these in a manner comparable with our own, thus making a composite picture of the measurements of nearly two hundred individuals. The source of previous recorded measurements of Australian Aboriginals of which we have been able to avail ourselves are as follow:—

(1) Dr. Roy Burston.
Bulletin of the Northern Territory of Australia.
Bulletin No. 7A, July, 1913.

(2) Spencer and Gillen.
The Native Tribes of Central Australia, 1899. Appendix C, p. 644—our "List I."

(3) Spencer and Gillen.
The Northern Tribes of Central Australia, 1904. Appendix A, p. 766—our "List II."

(4) E. C. Stirling.
The Horn Expedition, vol. iv., Anthropology, pp. 140, 141.

(5) R. Brough Smyth.
The Aborigines of Victoria, vol. i., pp. 1-4.

Among these sources of information the work of Burston stands out pre-eminently for its thoroughness and its scope. No less than 82 measurements were taken of each individual, and over 100 individuals were examined. It seems evident that this extremely important piece of work has not had the recognition it deserves, and it is worth mentioning that no copy of the paper appears to be available in any educational institution in Adelaide. Burston's measurements, though unfortunately little known to anthropologists in general, form the backbone of our knowledge of the anthropometry of the Aboriginal, and it is unlikely that such another contribution to the literature of this subject will be forthcoming unless financial aid and administrative encouragement are one day given to the study of the Australian Aboriginal. In Table III. a survey of the results of the present writers, and those obtained by previous workers, is recorded. The columns give the mean of measurements taken from the total number of individuals examined, and also for the males and females separately. The number of adults embraced in these tables is as follows:—

		Males.	Females.
Wood Jones and Campbell	Total 10	6	4
Burston	Total 93	62	31
Spencer and Gillen (1)	Total 30	20	10
Spencer and Gillen (2)	Total 40	23	17
Stirling—For stature only	Total 50	39	11
For complete measurements	Total 1	1	—
Brough Smyth—For stature only ..	Total 86	60	26

Totals—For complete measurements, 174—Males 112, females 62.
Totals—For stature only, 309—Males 210, females 99.

The blank spaces in the tables indicate that the measurement was either not taken by the earlier observers or else was not in accord with the standard requirements followed by the present writers.

TABLE III.

Comparative Table of Mean Values.

Observation	Wood Jones and Campbell			Spencer and Gillen List I			Spencer and Gillen List II			E. C. Stirling			R. Burston		
	Total	Male	Fem.	Total	Male	Fem.	Total	Male	Fem.	Total	Male	Fem.	Total	Male	Fem.
1	1608·6	1652	1543	1631·8	1663	1568	1662·3	1714	1591	1599	1671	1543	1660·7	1706	1570
2	1367·7	1572	1311	1366·7	1397	1304							1381·9	1418	1310
3	1338·7	1538	1290	1354	1383	1296	1381·3	1425	1322		1370		1382·9	1405	1338
4	785·9	809	752	773·4	780	760	792·5	817	759		773		802	822	762
5	1687·1	1747	1598	1685·4	1723	1610	1761·8	1815	1688		1545		1719·3	1779	1600
6	355·0	385	325				322·4	334	305				341·7	358	310
7	187·2	195	176	186·6	189	180	188·5	192	183		198		188·1	192	180
8	139·6	143	134	139·8	141	136	135·3	138	131		138		137·7	140	133
9	122·9	122	124				127·6	131	122		114		132·6	135	133
10	103·5	112	91	79·2	82	73	110·7	115	105				112·3	117	103
11	181·4	192	169	187·6	196	170									
12	133·1	137	126	138·5	142	131	128·6	133	122		138		135·4	139	127
13	112·7	114	110	108·4	109	107							111·4	112	109
14	102·5	106	97	97·1	98	94	101·2	105	96				102·5	105	96
15	107·5	110	104				105·8	107	103				103·7	106	99
16	94·3	96	91				93·4	94	91				92·4	94	89
17	35·3	36	34				34·2	35	33				35·9	37	35
18	132·3	134	129				122 9	124	121				121·1	124	114
19	44·6	49	38	49·6	51	46	47·2	48	45		53		47·6	49	45
20	46·3	50	41	46·8	48	43	49·1	51	46		46		44·4	46	41
21	41·9	46	35										40·9	42	38
22	60·5	64	56												
23	63·0	65	59				64·1	66	62				62·6	64	60
24	33·9	36	31				36·7	38	35				34·1	35	33
25	730·9	765	680	764·7	781	730	789 6	812	760		729				
26	323·4	332	310										321·7	334	297
27	262·7	269	253										256·9	266	238
28	188·5	196	177										171·9	177	163
29	77·3	82	71										76·3	79	71
30	929·8	928	932	891·3	917	833									
31	874·1	869	881												
32	447·2	448	446										441·9	454	417
33	427·1	421	435										393·5	405	371
34	250·5	260	237	245·3	251	234					247		249·3	259	231
35	91·0	92	90										96·6	101	88

In Table III. it is to be noted that the figures given by Spencer and Gillen in List I. for the facial length—observation No. 10—are so different from those recorded by the present authors and by Burston as to suggest the use of different measuring points. However, the same measurements taken by the same authors, and recorded in List II., are so nearly in harmony with our own as to render the explanation of the low values in List I. uncertain.

Stature.—A great many more observations have been made on stature than on other body measurements, since many observers who have not had the advantage of a complete anthropometric outfit or have lacked a knowledge of the other body

measurements usually recorded, have measured the total standing height of subjects. Brough Smyth records the following figures:—

	No. of Individuals.	Mean.
Total	86	1626·4
Males	60	1671·3
Females	26	1522·5

Topinard in his "Anthropology" (1890, pp. 320, 321) gives the following figures for the stature of Australian Aboriginals. The total number of individuals and the sexes are not recorded:—

Topinard's observations	1,718
Lesson's observations	1,575

Using all the available records sufficiently precise to be of any scientific value we may record the mean values for a few of the more important observations. These figures are founded on a fair number of individual measurements, and the business of abstracting the means of all available data is being continued by the present writers: —

Observation.	Total individuals.	Mean.	Total males.	Mean.	Total females.	Mean.
Stature ..	309	1636·9	210	1684·8	99	1557
Cranial length	173	187·9	112	191·9	61	168·8
Cranial breadth	173	137·6	111	140·1	62	133·1

Indices.—We have worked out the mean values of a number of indices derived from our own measurements. For comparison with the results obtained by others, dealing with individuals of other tribes, we have worked out the mean values of some of the cranial indices from the figures recorded by other observers.

This work is still in progress, and for the present has been limited to the most apparently important measurements.

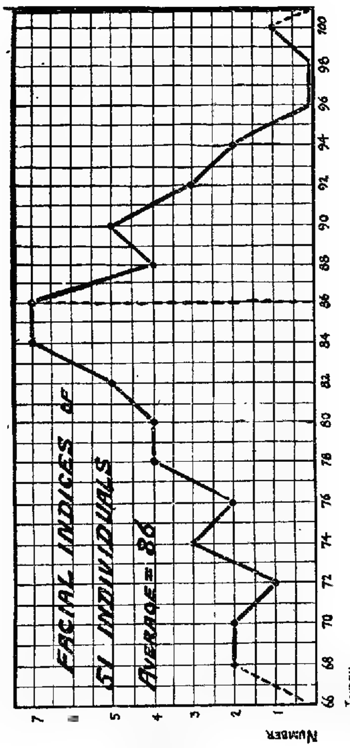
ARITHMETICAL MEAN OF INDICES.

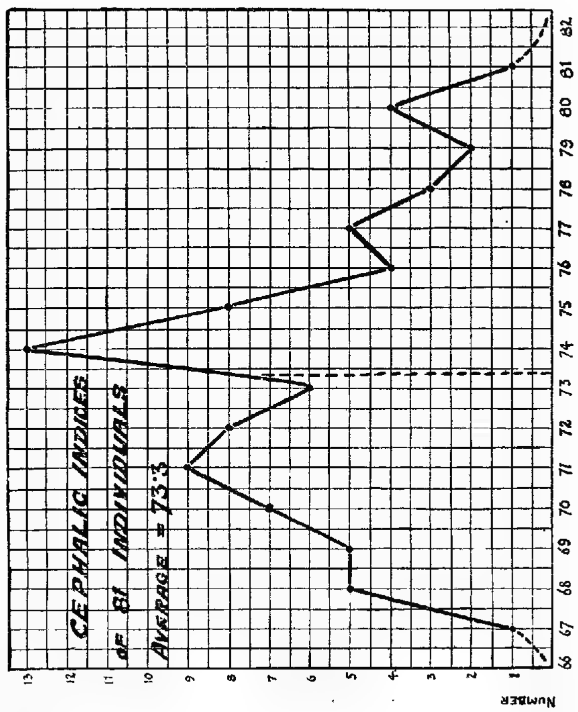
	Wood Jones and Campbell		Spencer and Gillen List I.		Spencer and Gillen List II.		E. C. Stirling	
	Number of individuals	Mean	Number of individuals	Mean	Number of individuals	Mean	Number of individuals	Mean
Cephalic ...	10	74·6	30	75	40	71·8	1	69 6
Facial ...	10	77 5			40	86·5	1	71·7
Nasal ...	10	104·6	30	94·7	40	104 6	1	86·8
Ear	10	53·8			40	57·3		

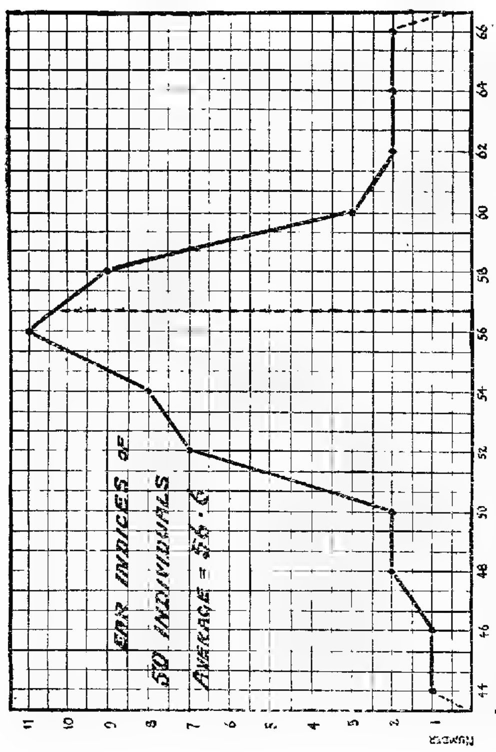
From our own observations alone we have abstracted a few more indices, and these, like the last, must be regarded only as a preliminary contribution. We have for the present confined ourselves to certain body and limb measurements in order to obtain, if possible, a concrete idea of the mean body and limb proportions of the Australian Aboriginal:—

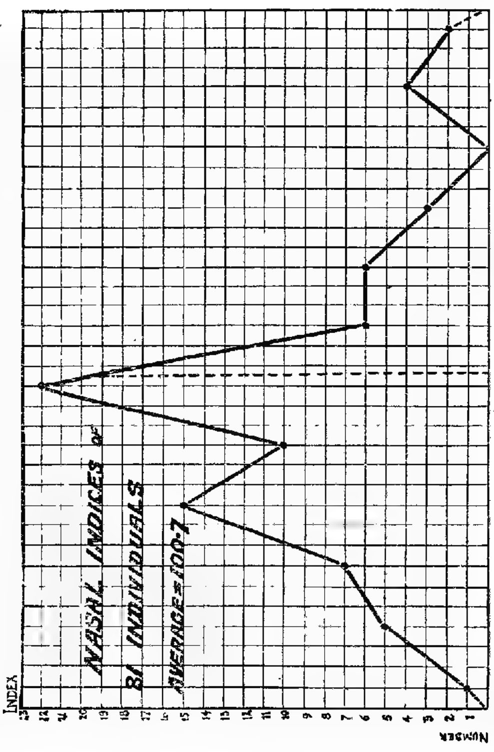
Arm—Stature index	45·3
Leg—Stature index	57·8
Radio—Humeral index	81·4
Tibio—Femoral index	95·9

311


FACIAL INDICES OF
51 INDIVIDUALS
AVERAGE = 86
INDEX
NUMBER


CEPHALIC INDICES
OF 81 INDIVIDUALS
AVERAGE = 73·3
INDEX
NUMBER


EAR INDICES OF
50 INDIVIDUALS
NUMBER


NASAL INDICES OF
81 INDIVIDUALS
AVERAGE = 100·7
INDEX
NUMBER

From the indices that have so far been completed it will be seen that the Australian Aboriginal falls into the following classification groups:—

Head form, dolichocephalic.
Nose form, markedly platyrhinic.
Radio—Humeral index, dolichokerkik.
Tibio—Femoral index, markedly dolichocnemic.

Expressed in another way, we may say that we have now a sufficient numerical basis to guarantee the assertion that the Australian Aboriginal has a long head; he has a remarkable widespread nose, long forearms, and remarkably long legs from the knee downwards.

In order to make some of our results clearer we have represented them in graphic form as frequency curves. These curves include the indices for ear, face, nose, and head, and embrace the observations given in the above table of Arithmetical Mean of Indices.

In this paper we have made no attempt at instituting comparisons between the figures we have obtained and the indices we have worked out from all recorded observations and similar values recorded for other races. All this must come later. Meanwhile we would express the hope that the burden we have undertaken of keeping a record of the anthropometric observations made on the Australian Aboriginals will become an increasingly irksome business. It is surely a remarkable thing that all over the southern portion of South Australia a native population has passed, or is rapidly passing away, without any satisfactory record ever having been made of the simplest measurements of the bodily form. It is high time this was remedied, and as a step towards the remedy these results—a tithe of what is requisite and due—are recorded.

Note on Finger Prints.

Finger prints of all ten individuals examined by us were recorded. Through the kindness of Commissioner Leane these were submitted for examination to the experts of the Criminal Investigation Department. Mr. F. E. Brice, of the C.I.D., has reported that the finger prints of the group of natives here considered show a condition entirely in accord with all other prints of Aboriginals which he has examined, their characteristic feature being consistent whorls.

EXPLANATION OF PLATES XXIX. and XXX.

Plate XXIX.

Full face and profile photographs of (from left to right) subjects A, B, C, and D.

Plate XXX.

Full face and profile photographs of (from left to right) subjects E, F, G, and H.

THE CHITON FAUNA (POLYPLACOPHORA) OF PORT STEPHENS, NEW SOUTH WALES.

By Edwin Ashby, F.L.S., M.B.O.U.

[Read June 12, 1924.]

Plate XXXI. (in part).

Port Stephens, as far as we have been able to ascertain, has never been thoroughly explored for Polyplacophora. The only record, we were aware of, of work done in this neighbourhood is a note by A. F. Basset Hull, in his paper on "New Australian Polyplacophora and Notes on the Distribution of certain Species" (Austr. Zool., vol. iii., 1923), in which he states, *inter alia*, "I have examined Port Stephens . . .", but no further mention is made. Subsequently, in the same paper (p. 164), in reference to *Rhyssoplax carnosus*, Angas, he writes, "It has been my good fortune to examine . . . examples from Port Stephens." Apparently these are the only published notes on the chitons of this vicinity.

The advance party, consisting of W. L. May and the writer, reached Port Stephens on October 4, 1923, and were joined by Messrs. Albert E. J. and H. W. Thackway two days later, making our headquarters at Nelson Bay, which is about 90 miles N.W. by N. of Sydney and about 20 miles north of Newcastle. The reefs upon which the Polyplacophora were collected consist of weathered felspar porphyry.

Owing to the limited time at our disposal and the long length of coast which had to be examined, our attention was confined to the southern shore between Dutchman Bay and Tomaree (South) Head, and the open sea coast, from the latter head to Fingal Point, a distance in all of about 15 miles. The advance party had noted some rocky points west of Nelson Bay from the deck of the little steamer, and as far as the unfavourable tides would permit, spent the first two days in investigating the neighbourhood for promising spots. Several places were tried westward (further up the harbour), but the results were not very encouraging; this was probably due to the dirty character of the water.

On the arrival of the Messrs. Thackway, by dividing the party into two, the coastline to Tomaree Head was explored. The real work began on October 8, taking advantage of the spring tides which reached their maximum low point on the 10th idem.

As the Thackways were able to continue their stay for about a fortnight after those of us from the other States had left, they were able to extend the investigation to the open coast outside the heads, and to add very materially to the sum-total of the material collected. My heartiest thanks are due to Albert E. J. Thackway and W. L. May for the loan of material, and to the former for the use of his very copious notes on the material collected and the ground examined.

Reefs at each end of Nelson Bay were found to be moderately good; sixteen species being secured on the western reef, between the old wharf and Dutchman Bay, and eighteen species on the eastern. The western reef was remarkable for the large colonies of excellently preserved specimens of *Onithochiton quercinus*, as was the eastern for numbers of an exceptional colour variety of *Haploplax lentiginosus*. A cursory examination was made of the reef around Nelson Head,

with favourable results; time was too limited for as thorough an examination as is desirable. Further investigation will probably prove this point to be one of the richest in the harbour. The coast between the eastern end of Shoal Bay and Tomaree Head was most disappointing, although a whole day was occupied in prospecting it, nothing worthy of being noted was taken over a distance of approximately of one mile.

Along considerable strips of this coast, many of the stones examined were bare of apparent life, and in numerous instances large areas of seemingly good ground were found to be quite barren. The headlands at False Bay, on the open ocean, were even poorer than at Tomaree Head; the causes of the apparent paucity of life in these localities seem obscure and are worthy of careful investigation.

The most profitable ground was located at Fly Point and extended for nearly half a mile between Nelson Bay and Little Bay. Only a small portion of this fine ground was touched, but it was found extremely rich both in species and in examples, as the appended notes testify. Examples of every genus recorded from New South Wales, with the exception of *Choriplax*, *Liolophura*, and *Tonicia*, were taken within a distance of less than a quarter of a mile. The results of the united labours of our party were most gratifying, yielding, as they did, a wealth of specimens, including most of the recorded fauna in New South Wales; many individual specimens are of exceptional beauty. One new species of *Acanthochiton* is described and another member of the same genus is added to the fauna of the State; 28 species besides named varieties were secured. The entire absence of *Liolophura gaimardi*, Blainville, which is such a common species at Port Jackson, is remarkable.

All measurements quoted in this record are of dried specimens.

Family Lepidopleuridae, Pilsbry.

Lepidopleurus badius.

Lepidopleurus badius, Hedley and Hull, Rec. Austr. Mus., vii., 1909, p. 260.

Specimens of this species were rare, half a dozen in all being taken, ranging from 3×1·5 mm. to 5×2·5 mm. The examples were mostly found on small stones embedded in shell-sand and in comparatively shallow water. One specimen was taken in a small rock pool near high-tide mark. A wide range of colour variation was shown, the series ranging from a brick-red to a light straw. This species was only found within a very limited area on Fly Point.

Family Callochitonidae, Thiele.

Callochiton platessa.

Chiton platessa, Gould, Proc. Bos. Soc. Nat. Hist., ii., 1864, p. 194.

Callochiton platessa, Gould, of Pilsbry, Man. Conch., xiv., p. 49, pl. 10, figs. 1-5.

Fairly common at Fly Point and on the reef between Nelson and Dutchman Bays. A good series in all stages of growth, the largest specimen taken measured 28×17 mm. All typical specimens, the various shades of red and green assimilating with the colours of the encrusted rocks upon which they were found.

Callochiton platessa, Gould, var. fossa, Ashby.

(Trans. Roy. Soc. S. Austr., vol. xlvi., 1922, p. 19).

A few specimens of this pitted form were found.

Family Ischnochitonidae, Pilsbry.

Ischnochiton (Lineolatus) crispus.

Chiton lineolatus, Blainville, Dict. Sci. Nat., vol. xxxvi., p. 541.

Chiton crispus, Reeve, Icon., pl. 19, f. 120, May, 1847.

Ischnochiton lineolatus crispus, Rv., of Ashby, Trans. Roy. Soc. S. Austr., vol. xliv., 1920, pp. 273, 274.

This sub-species, although by no means rare, was not as plentiful as might have been expected. The specimens taken were mostly comparatively small, but a very beautiful series of colour variations was obtained. The largest measures 30×14 mm. Examples were met with on all reefs between Dutchman Bay and Shoal Bay; none were seen at Tomaree Head, or on the coastal reefs. It is worthy of note that in the locality under review, *crispus* was principally obtained in fairly deep water.

Ischnochiton proteus.

Chiton proteus, Reeve, Conch. Icon., iv., 1847, pl. 8, f. 11; *C. divergens,* Reeve, *l.c.,* pl. 18, f. 44.

This species and the following one, *fruticosus,* are the commonest chitons in the district. Numerous examples were found in every place explored and in every stage of growth. Some stones examined were literally covered with these. Very large and clean specimens were frequently taken and a remarkable series of colour variation embracing ground colours of greens, whites, reds, and browns, with varying patterns and colour markings, was observed.

Ischnochiton fruticosus.

Chiton fruticosus, Gould, Proc. Bos. Soc. Nat. Hist., ii., p. 142, 1846.

Equally numerous with the preceding species and found at all levels, from half tide to deep water. A few examples of a novel green variety, with burnt-umber dorsal region and brown girdle, were secured.

Ischnochiton examinandus.

Ischnochiton examinandus, Hull, Austr. Zool., vol. iii., pt. iv., 1923, p. 160, pl. xxv., f. 1-4.

Comparatively rare; about a dozen specimens in all were collected, the sizes varying from 7×4·5 mm. to 15×8 mm. Of these, three were similar in colouration to the type, the remainder show general schemes of green, orange, or brown. Slight differences in the shape occur, some being more elongate than the others.

Ischnochiton (Haploplax) smaragdinus.

Lophyrus smaragdinus, Angas, Proc. Zool. Soc., 1867, p. 115, pl. 13, f. 28.

Ischnochiton smaragdinus, Pilsbry, Proc. Ac. Nat. Sci., Phil., 1894.

This species is very common at all places examined between Nelson Bay and Fly Point, inclusive, and was one of the few species found in the neighbourhood of Tomaree Head. The largest specimen taken was 23×13 mm., and the variation in colour scheme and pattern was very great.

Ischnochiton smaragdinus, Angas, var. picturatus, Pilsbry, Proc. Ac. Nat. Sci., Phil., 1894, p. 72.

Very numerous in the same localities as the typical form, but none were seen on the open coast; they were found both in deep water and in rock pools above low-tide mark.

Ischnochiton smaragdinus, var. funereus, n. var.

A very distinctive variety of *Haploplax smaragdinus,* in which the whole of the tegmentum is of a uniform black, without any colour relief, and the girdle is consistently of a yellow tint, varying in shade from light straw to golden-yellow, transversely banded at irregular distances, with narrow bands of a darker

tint, suggesting shadows. The sculpture and girdle scales are similar to typical shells.

As this variety is so distinct and exceptional in colour to any other New South Wales shell, it seems worthy of a distinctive name. I therefore suggest the name *funereus* for this variety. Besides the few examples taken at Port Stephens, both Thackway and Hatcher have taken it at Long Reef, and the former has taken it at Mereweather, Botany Bay, Bulli, and Port Jackson; the writer also found an example, 17 mm. in length, on the one occasion he has visited Vaucluse. The type measures 12×7 mm., is from Long Reef, and was given to me by Mr. W. H. Hatcher.

Ischnochiton (Haploplax) lentiginosus.

Chiton lentiginosus, Sowerby, Mag. Nat. Hist., iv., 1840, p. 293.
Chiton lentiginosus, Reeve, Conch. Icon., iv., 1847, pl. 24, f. 165.
Ischnochiton lentiginosus, Pilsbry, Proc. Ac. Nat. Sci., Phil., 1894, p. 73.

Very common on all reefs. The specimens collected are of an unusual colour pattern for this species, and may probably be regarded as a local variety. Nearly all the examples are confined to different shades of brown. The Port Stephens form has an irregular, dark, dorsal stripe on all valves, which is margined on either side by a lighter band, the whole being maculated with the typical blue spots and lines. Examples from Bulli and Long Reef (near Manly) mostly have a monochrome ground, decorated with the usual blue marks.

Ischnoradsia australis.

Chiton australis, Sowerby, Mag. Nat. Hist., iv., 1840.
Ischnochiton australis, Reeve, Conch. Icon., iv., 1847.

In numbers this species was second only to *proteus* and *fruticosus;* specimens were collected at all points, but in common with other species, were scarce around Tomaree Head.

Subfamily Callistoplacinae, Pilsbry.

Callistochiton antiquus.

Chiton antiquus, Reeve, Conch. Icon., iv., 1847, pl. 25, f. 169.

A long series was obtained at Fly Point and Nelson Head; these are all of the usual form and are nice clean examples. This chiton was quite difficult to locate owing to its colour and sculpture, assimilating, as it does, so well with the rocks upon which it is found.

Family Mopaliidae, Pilsbry.

Plaxiphora albida.

Chiton albidus, Blainville, Dict. Sci. Nat., vol. xxxvi., 1825, p. 547.
C. costatus, Blainville, *l.c.*, p. 548. Discussed by Iredale, Proc. Mal. Soc., ix., pt. ii., p. 96.
Plaxiphora albida, Blainville, of Ashby, Trans. Roy. Soc. S. Austr., vol. xlvi., 1922, pp. 575, 576.

Over a score of specimens were taken, but this species is not plentiful in the portions of the coast examined. The shells on the average are smaller than those found further south. All specimens collected were from levels between high and low-tide marks; none were seen below the latter, and all were covered with algae.

Note.—As I have stated in several of my earlier papers, it has been found that examples of members of this genus from Queensland, in the north, round the south coast of Australia, and up the west coast of Western Australia, as far as Dongarra, show so much variation both in shape and sculpture, with apparent

intermediates, that it has seemed best to make no attempt to define separate species, until a very large series was available from all parts of the Australian coastline.

The examples from Port Stephens form a very welcome addition to what is already a very representative collection. The writer's experience very closely coincides with the views expressed by Iredale in the paper above cited.

Family Acanthochitidae, Pilsbry.

Acanthochiton granostriatus.

Acanthochites granostriatus, Pilsbry, Naut., vii., p. 119, 1894.

Acanthochiton granostriatus, Pilsbry, of Ashby, Trans. Roy. Soc. S. Austr., vol. xliv., 1920, pp. 287, 288.

This species was not numerous, but a fair series was collected, mostly showing brighter colouration than specimens found in South Australia.

Acanthochiton pilsbryi, maughaneanus.

Acanthochiton pilsbryi, Sykes, Proc. Mal. Soc., Lond., vol. ii., pt. 2, 1896.

Acanthochiton maughani, Torr and Ashby, Trans. Roy. Soc. S. Austr., 1898, p. 12.

Acanthochiton pilsbryi maughaneanus, Ashby, Trans. Roy. Soc. S. Austr., vol. xliii., 1919.

A few very fine specimens were obtained measuring up to 12×4·5 mm. On the way to Port Stephens some of our party broke their journey at Point Clare, on Brisbane Water, and there found three examples of this shell in which the granules were more irregular in shape than is normal.

Acanthochiton variabilis.

Hanleya variabilis, Adams and Angas, P.Z.S., 1864, p. 194.

Acanthochites variabilis, Adams and Angas, of Pilsbry, Proc. Ac. Nat. Sci., Phil., 1894, p. 184.

This widely distributed species was by no means common at Port Stephens; one or two of the specimens collected show the bright blue colouration which seems to be a feature of those collected by Hatcher at Long Reef, near Manly.

Acanthochiton kimberi.

Acanthochites kimberi, Torr, Trans. Roy. Soc. S. Austr., vol. xxxvi., 1912.

This shell has not previously been recorded from the State of New South Wales, and it was an unexpected pleasure to meet with it so far from the type locality in South Australia. Several very fine specimens were secured, the largest measuring 18×6 mm.; the previously known largest specimen is one collected by Mawle, in Port Arthur, in Tasmania, that measures 16·5×7·5 mm.

As it is not difficult to confuse this shell with the variety of *Acanthochiton retrojectus*, named by the writer *pustulosus*, Ashby, the following comparison should be helpful. In *pustulosus*, the girdle fringe is often not visible, but in larger specimens, when present, the fringe is shorter and spicules more slender than in *kimberi*. In the sculpture, the large granules of *pustulosus* are always strongly convex and strongly elevated, in *kimberi* the larger granules are flat though very irregular in size, often very elongate. Under a magnification of 65, the minute grains clothing the girdle of *retrojectus* and its variety *pustulosus* are larger than those in *kimberi*, and seem to coalesce in irregular masses; whereas in *kimberi*, in addition to the grains being more minute, they lie more smoothly and are so arranged in groups, that collectively they form shallow rings with a hole or crater in the centre.

A very beautiful variety was secured by Thackway, in which the first two valves are white; valves 3, 4, and 5, red; valves 6 and 7, white with red dorsal area; and tail valve dark.

Acanthochiton retrojectus.

Acanthochites retrojectus, Pilsbry, Naut., vii., p. 107, 1894.

This little species was not common, but specimens were taken up to 14×5·5 mm.

Acanthochiton retrojectus, var. pustulosus.

Acanthochiton retrojectus, var. *pustulosus*, Ashby, Trans. Roy. Soc. S. Austr., vol. xlvi., 1922, pp. 15, 16.

Several examples of this striking variety of *retrojectus* were met with; in some the large granules are developed at a very juvenile stage, in others the sculpture is quite typical of *retrojectus* until the shell is more than half grown, when the very coarse, highly elevated grains are produced.

Acanthochiton thackwayi, n. sp.

Pl. xxxi., figs. 1, 2.

General Appearance.—Broad, girdle almost entirely covered by the long extruded spicules, a dense rather long girdle fringe, shell highly arched and rounded, side slope curved, median valves beaked.

Colour.—Pale creamy-brown, dorsal area of valve 2 rose pink, spicules similar in colour to the valves.

Anterior Valve.—This valve is unusually elevated, slope curved and steep, 5 ray ribs or undulations, the two lateral ones being shallow, the three in the centre ones strongly elevated, closer together and with deep troughs between them. The ribs are decorated with two rows of closely packed, small, rounded, cream-coloured granules.

Posterior Valve.—Small, mucro not raised, median or postmedian, posterior slope steep, covered with closely packed, cream-coloured granules. Dorsal area pinnatifid and in proportion to the size of this valve, broad, dark coloured; the pleural area of this valve is decorated with small closely packed granules, placed in longitudinal rows.

Median Valves.—Broad, elevated, arched, side slope curved, posterior margin strongly beaked, the shell bending outwards again towards the girdle, quite as far, if not further, than the beak. The dorsal area is broadly wedge-shape, the beak is a little rugose, but this may be due to slight erosion; under a pocket lens, only the posterior half of this area is smooth, and from there, anteriorly, the area appears strongly grooved, but under a Zeiss binocular, mag. 65 times, this apparent grooving is found to be only simulated by an alternation of dark, subcutaneous, longitudinal lining with white opal-like lining, so that, except for transverse growth lines, this area is smooth. This area is strongly pinnatifid, four of the lateral "teeth or pinnae," which are cream-white, can be counted on each side of the dorsal area; from each of their apices commences a more or less longitudinal row of small closely packed granules; the pleural and lateral areas are not separable, both being similarly sculptured with bowed, more or less longitudinal, rows of minute, bead-like, closely packed granules; these granules are so closely packed in the rows that, under a pocket lens, they appear everywhere touching, and the rows are so close to one another that there is no well-defined suture between them. The grains towards the outer margin are but little larger than those nearer the dorsal area. Under a binocular with 65 magnifications the granules are less bead-like, are not hemispheres, as they appear under a high-power pocket lens, but are strongly raised, circular, convex granules, the curvature being flatter in some than others; also, they rarely imbricate, although so close together, and are usually separated.

The interspaces between the grains, although the shell has been boiled for some time, still seem partially filled with the most minute grains of sand.

Girdle.—Is furnished at the sutures with hair tufts of exceptionally long, slender, glassy spicules, and under mag. 65 times, shorter, extremely slender spines are interspersed amongst them. The girdle fringe is very dense, seemingly composed of three rows of spicules; the rest of the girdle is covered with coalesced, minute grains.

Measurements.—The type is 9×4·5 mm., including the hair tufts; shell itself only 7×4·5 mm. Thackway's specimen 9·5×5 mm.

Habitat.—In addition to the type, which was collected by the writer at Fly Point, a second specimen was taken by Mr. Albert E. J. Thackway at the same spot.

In conclusion.—This species is distinguished from *bednalli* by the dorsal area being pinnatifid and smooth, although simulating grooving by subcutaneous lining, and by the granules being circular and convex, whereas in *bednalli* they are longer and flat-topped. The same characters still more widely differentiate it from *granostriatus.*

ACANTHOCHITON (NOTOPLAX) COSTATUS.

Acanthochites costatus, Adams and Angas, P.Z.S., 1864, p. 194.

Macandrellus costatus, Dall., Proc. U.S. Nat. Mus., i., p. 81.

Notoplax costatus, Adams and Angas, of Ashby, Trans. Roy. Soc. S. Austr., vol. xliv., 1920.

Three specimens of this shell were taken; the largest 19 mm. long, girdle evenly but not densely covered with short spicules. The ribs on valves in the smallest specimen are considerably less raised than those of the other two. In Tasmania all the examples seen from Port Arthur have shallow ribs, whereas those taken in the D'Entrecasteaux Channel all have coarse ribs.

Family CRYPTOPLACIDAE, Dall.

CRYPTOPLAX ROSTRATUS.

Chitonellus rostratus, Reeve, Conch. Icon., f. 6, 1847.

Cryptoplax torresianus, Rochebrune, Bull. Soc. Philom., Paris, 1881-1892, p. 195.

Cryptoplax rostratus, Rv., of Ashby, Trans. Roy. Soc. S. Austr., vol. xlvii., 1923.

This chiton was very numerous, several specimens being taken up to 63 mm. in length (dried specimens); in life they would have measured considerably more. While the girdles of most were densely clad with normal, brown spicules, a few had orange-brown spicules, making them very conspicuous in the water, also, in a few examples, the dorsal area in each valve is porcelain-white, the rest of the valves brown; in these the dorsal area, especially at the beak, is touched up with pink.

In my discussion of this species in the paper cited above occur these words: "Also the valves *C. rostratus,* even in the fully adult shell, still touch one another." Having now examined the large number of specimens taken at Port Stephens, I find I have to qualify this statement, for in the very large specimens, after valve 4, the valves are distinctly spaced; but this feature, which is normal in *C. striatus,* Lamarck, does not seem to occur in *rostratus* until reaching extreme senility. The granular character of the sculpture is retained even in the largest specimens, but the granules are less bead-like and more elongate than is the case in younger examples.

Family CHITONIDAE, Pilsbry.

RHYSSOPLAX JUGOSUS.

Chiton jugosus, Gould, Proc. Bos. Soc. Nat. Hist., ii., p. 142, 1864.

Rhyssoplax jugosus, Thiele, das Gebiss der Schnecken, vol. ii., p. 368.

A very fine series with wide variation in the colour pattern was taken.

RHYSSOPLAX COXI.

Chiton coxi, Pilsbry, Proc. Ac. Nat. Sci., Phil., 1894, p. 85.

A fair number were secured; most of them were more or less normal, olivaceous, flecked with cream and pink markings. In one remarkable specimen, measuring 15×9 mm., all the valves, other than valve 2, are brilliant, absinthe-green, with a bright pink spot at the apex of the anterior valve and at the beak of the other valves; valve 2 is ox-blood-red, and the whole of the girdle is broadly and irregularly banded in these colours, with the addition of cream-white and three or four narrow, very dark, reddish bands. Altogether, it is perhaps the most brilliantly coloured chiton I have ever seen. (Ridgway's Colour Standards, pls. xxvi. and i.)

RHYSSOPLAX CARNOSUS.

Chiton carnosus (Carp. MSS.), Angas, P.Z.S., 1867, p. 222.

Rhyssoplax jacksoniensis, Ashby, non *Chiton limans*, of Sykes, Proc. Roy. Soc. Vict., 33 (n.s.), 1921.

Rhyssoplax carnosus, Angas, of Hull, Austr. Zool., vol. iii., pt. iv., 1923.

Amongst the series collected were some of the most brilliantly coloured forms yet obtained, ranging from normal, mottled olivaceous, through cream, with three or four dark, almost black, valves to pink, brick-red, and orange.

RHYSSOPLAX VAUCLUSENSIS.

Chiton vauclusensis, Hedley and Hull, Rec. Austr. Mus., 1909, p. 261, pl. lxxiv., figs. 19-23.

Several examples of this fine and rare chiton were collected, Port Stephens being an entirely new locality. I am also glad to be able to record that my correspondent, William H. Hatcher, has also been successful in finding it at Long Reef, near Manly. Thus, although still a rare shell, its habitat is slowly yet surely being extended.

RHYSSOPLAX TRANSLUCENS.

Chiton translucens, Hedley and Hull, *l.c.*

A good series of exceptionally fine specimens of this beautiful chiton was obtained measuring up to 41×21 mm. Most of them are coloured with soft shades of flesh-pink, variously blotched with olive; only one or two were of the green shade, with cream markings, mentioned in the description of the type.

SYPHAROCHITON PELLIS-SERPENTIS.

Chiton pellis-serpentis, Quoy and Gaimard, Zool. Astrolabe, iii., 1835, p. 381, pl. 74, figs. 17-22.

Sypharochiton pellis-serpentis, Q. and G., of Thiele, *l.c.*, p. 365.

In addition to our general research, two whole days were entirely devoted by the Messrs. Thackway in an endeavour to locate this species, and their labours were finally rewarded, when Mr. H. W. Thackway found a single specimen, near low water-mark, on the reef at the eastern end of Nelson Bay. This was almost the last chiton obtained during the visit. The search extended over the whole of the suitable ground between Dutchman Bay, in Port Stephens, and Fingal Point, on the open coast, covering a distance, in all, approximately, of 15 miles. With the exception of this single specimen, which Mr. Thackway has generously presented to the writer, no other example of this species, or of its associate in New South Wales waters, *Liolophura gaimardi*, Blainville, was met with; the specimen taken is typical of the form found at Port Jackson with the strong longitudinal ribbing; in southern Tasmania such strongly sculptured forms are far less common than the smoother ones.

Some additional notes on this chiton seem worth while. This species, in both New South Wales and Tasmania, is found from half-tide almost to high

water-mark, and is common throughout the southern coasts of the former State; and on the north, east, and southern coasts of the latter State. Eroded specimens exposed to sun and air below high tide-mark may be found in large colonies within the areas named, in both States, but well-preserved specimens are moderately rare.

Thackway, May, and the writer have each been able to take a fair series of perfect specimens in their respective localities, from the underneath of large boulders, or in fissures, or caverns, into which the sun never penetrates, *i.e.*, places which, although above low water, are constantly damp or moist, and comparatively dark.

North of Sydney, *pellis-serpentis* seems to become rarer. At Mereweather, about four miles south of Newcastle, during October, 1923, Thackway made a search for this species along two miles of coast, when only three specimens were found. At Point Clare, on Brisbane water, north of the Hawkesbury, the writer took several specimens in a fair state of preservation, but it was not common there. In face of these evidences and the fact, that with all our searching, Port Stephens only yielded us one specimen, it seems probable that the Port is the northern limit of its range. Messrs. Iredale and May distinguished the Tasmanian forms of this shell, under the designation of *Maugeanus;* while I think the better way would be to consider them mere varieties of the New Zealand shell, if students prefer to consider the Tasmanian shell a geographic race, I suggest that the somewhat more highly sculptured form, found in New South Wales, be distinguished by the subspecific name of *septentriones*, a name suggested by the more northern habitat.

Subfamily Liolophurinae, Pilsbry.

Lorica volvox.

Chiton volvox, Reeve, Conch. Icon., pl. 6, f. 31, 1847.

This species was not common, less than a score of specimens being found, the largest measuring 60 mm. in length; they were typical of Port Jackson shells.

Loricella torri.

Loricella torri, Ashby, Trans. Roy. Soc. S. Austr., vol. xliii., 1919.

A long series was collected ranging from quite juveniles up to 52×36 mm. Shades of green and pink are quite common in the girdles, the lateral areas and anterior valves, in some, show strong granules, in others the shell is almost smooth. The girdle, in some, was thickly clothed with branching spicules or setae, in others this feature was much less in evidence. In none of the fine series examined was there any evidence of the "spear-headed spicules" discovered by the writer, and which are so striking a feature of the South Australian shell *Loricella angasi*, Adams and Angas.

Onithochiton quercinus.

Chiton quercinus, Gould, Proc. Bos. Soc. Nat. Hist., ii., p. 142.

A fair series of this Onithochiton was secured, some showing very beautiful colour markings.

Note.—I have followed Pilsbry in the foregoing order, but note that Thiele places the two genera, *Lorica* and *Loricella*, under the Family Ischnochitonidae, and the Genus *Onithochiton* under the Subfamily Acanthopleurinae, as a group under the Family Chitonidae.

Also, I would add the following record, which, although it has nothing to do with the fauna of Port Stephens, it is, nevertheless, an interesting record

belonging to the same State, and will be of interest to other workers. The only occasion upon which it has been possible for the writer to visit that famous collecting ground for chitons, the Bottle and Glass Rocks, at Vaucluse, was on September 25, 1923, and was rewarded by two good finds. One was a very fine specimen of *Acanthochiton kimberi*, Torr, measuring, when dry, 14×6·5 mm., but when alive nearly double the width, owing to the extension of the girdle, a feature that is little seen in the small specimens from South Australia. This was an altogether new find for the State of New South Wales. On another broken shell was another great find, a very fine specimen of *Lepidopleurus* which had never before been seen by the writer, but was immediately recognised as being Hull's new *L. puppis*, which up to the present is only represented by a very few examples. This specimen measures 13·5×6 mm. and is in perfect order.

DESCRIPTION OF PLATE XXXI.

(For description see page 327.)

FURTHER NOTES ON AUSTRALIAN POLYPLACOPHORA WITH DESCRIPTIONS OF THREE NEW SPECIES.

By Edwin Ashby, F.L.S., M.B.O.U.

[Read October 9, 1924.]

Plate XXXI. (in part).

Family Ischnochitonidae, Dall.

Subfamily Ischnochitoninae, Pilsbry.

Genus Ischnochiton, Gray.

Ischnochiton tindalei, n. sp.

Pl. xxxi., figs. 4*a*, 4*b*, 4*c*.

I am indebted to Sir Joseph Verco, Hon. Curator of Mollusca of the South Australian Museum, for the opportunity of describing this new *Ischnochiton*, which was collected by Mr. N. B. Tindale, of the same Museum, after whom I have pleasure in naming it. It was obtained at Groote Eylandt, in the Gulf of Carpentaria.

General Appearance.—Shell broad, valves arched but showing a slight angle at jugum, side-slope curved. Colour, Vinaceous Brown (Ridgway, pl. xl.).

Anterior Valve.—Is evenly and closely covered with spaced, circular, convex grains, which are exceptionally even in size, although a little smaller near the apex and a little larger near the margin; the interspaces are a little darker than the granules themselves; four broad, shallow, concentric growth-ridges are present in the type.

Median Valve.—Is arched, slight angle at jugum, dorsal area ill-defined, the arrangement of the granules and grain markings is longitudinal near the jugum, the granules are raised and circular, commencing small near the jugum and increasing to double the size and elevation in the pleural area; the lateral area is much raised, clearly defined, and equalling in size the pleural area; the granules are still circular but rapidly increase in size, both posteriorly and laterally; they are arranged in even, bowed rows both longitudinally and diagonally, forming a decussated pattern; the granules on the posterior margin are large and give a toothed appearance.

Posterior Valve.—This valve is large, mucro median, well defined, slope behind, for one-third, steep; other two-thirds, flatter. A strongly raised diagonal fold separates the posterior portion of the valve from the anterior; the posterior portion is similarly decussated, although a little less coarsely, to the lateral areas in the median valves, the anterior portion is similar in sculpture to the dorsal and pleural areas of those valves.

Articulamentum.—Is white, inside glassy white, anterior valve slits 9, fairly evenly spaced, teeth sharp; tail valve 8 slits, sutural laminae small, sinus between very wide. Median valves, slits 1/1, eaves well defined, insertion protruding slightly beyond the tegmentum, teeth sharp, sutural laminae small, sinus between very wide, tegmentum bowed outwardly in centre.

Measurements.—The shell was too crushed to allow of any accurate total measurement being given, but the two end valves and valve 2 are unbroken. The total of crushed shell is 8×5 mm. Anterior valve is longitudinally 1·5 mm., laterally 3 mm. Posterior valve is longitudinally 2·5 mm., laterally 3·5 mm. Median valve is longitudinally 1·5 mm., laterally 3·5 mm.

Girdle.—Densely clothed with minute, flat, imbricating scales.

Habitat.—Groote Eylandt, Gulf of Carpentaria, Northern Territory, living on a block of dead coral. Museum, No. D4656, one example.

Comparisons.—It differs from *I. luticolens,* Hull, in the very raised character of the lateral area, the slope from the pleural area to the lateral not being gradual, as in that species, but most abrupt. The shell is more elevated and the side-slope more curved, sculpture everywhere coarser, mucro central not anterior and posterior slope fairly steep, not concave, also *luticolens* has 50 per cent. more slits in the insertion of the end valves. It was at first my intention to describe this shell as a subspecies of *luticolens,* but the differences noted above, of form, sculpture, and slitting, seem to warrant its being given full specific rank, but it may be considered near to that shell.

Family Cryptoconchidae, Iredale.

Subfamily Cryptoconchinae, Ashby.

Genus Acanthochiton, Gray, em.

Acanthochiton macrocystialis, n. sp.

Pl. xxxi., figs. 3, *3a, 3b, 3c.*

Introduction.—I am much indebted to Mr. W. L. May, of Tasmania, for placing in my hands for definition several examples of a new *Acanthochiton.* They are especially interesting from the fact that they have, as their host, the long ribbon-like alga, *Macrocystis pyrifera,* var. *dubenii;* my thanks are also due to Mr. L. Rodway for kindly identifying the plant. The specimens were sent to Mr. May by Mr. E. W. Mawle with the following note:—"These Acanthochitons I collected at the outside of Port Puer; their host is the long ribbon-like kelp, that grows near the bull kelp. The Acanthos live near the roots. I had to cut the roots open to find them; it is like basket-work where they live."

I was able to show in my paper on the genus *Stenochiton* (Trans. Roy. Soc. S. Austr., vol. xlii., 1918, pp. 65-78) that members of that genus of Chitons do not live on rocks but on "sea grasses." In another paper *(l.c.,* vol. xlv., 1921, pp. 136-142) on the "Re-discovery of *Choriplax*" one was able to adduce data which suggests that members of that most remarkable genus live on the stems of *Laminaria.* The present discovery is of exceptional interest, because it seems to establish the fact that there are other races of Chitons that occupy a very similar ecological niche.

General Appearance.—In the dried specimen the girdle occupies two-fifths of the total width, shell elliptical, colour Hellebore Green to Elm Green (Ridgway, pl. xvii.), mottled with white, outer border dirty white, dorsal area of valves 2 and 8 dark. Shell is arched, thickly decorated with small granules, hair tufts conspicuous, girdle thickly beset with spicules.

Anterior Valve.—The central portion of this valve consists of a V-shaped elevation, corresponding with the three central ray ribs; the actual ribs can only be distinguished in the juvenile portion of shell near the apex. The two lateral ribs are modified into mere waves; the whole valve is decorated with irregularly arranged, small, elongate, flat granules, which are anteriorly rounded or subacute, laterally straight-sided, the granules are raised anteriorly and shallow posteriorly. Articulamentum white, slits 4, well defined and suture or sinus carried to the tegmentum, the three central slits correspond with the three central ribs and the fourth slit with the fold on the right, but the lefthand slit is obsolete.

In another juvenile specimen the anterior valve also has only 4 slits, the lefthand one being absent.

Posterior Valve.—Tegmentum small, mucro postmedian, slope steep immediately behind the mucro; the dorsal area broadly wedge-shape, rugulose transversely and subgranulose near mucro, longitudinal grooving absent, sculpture of rest of valve similar to that of the anterior valve. Articulamentum white, much produced laterally, slits 3 well defined and sinus deep, sutural laminae shallow, sinus between broad. A second juvenile specimen has three slits in the tail valve similarly spaced.

Median Valve.—The following is a description of valve 2. The dorsal area is raised, arched and beaked, without longitudinal grooving but showing a little subcutaneous lining, numerously, transversely ridged, pitted near beak. The lateral and pleural areas are similar in sculpture, there is a slight diagonal fold, the granules are similar in shape to those of the anterior valve, except that they are longer and more definitely subacute, the sides of some of the granules not being parallel but converging. The granules adjoining the dorsal area are very elongated and coalesce. The general arrangement of the rows of granules is longitudinal, parallel with the outer margin of the tegmentum. Articulamentum white, sutural laminae well produced forward, sinus between wide, insertion plate in this particular valve unslit, but in a juvenile specimen that has been disarticulated some of the median valves have slits 1/1, notches very short and inconspicuous but sinus carried to the tegmentum.

Girdle.—Hair tufts are large and composed of massed, slender spines; girdle is closely beset with coarser spicules.

Habitat.—Living on the roots of the alga *Macrocystis pyrifera,* off Point Puer, near Port Arthur, Tasmania.

Measurements.—Total of type 15·5×8 mm., largest specimen 20×9 mm., second largest 17×8 mm. Anterior valve longitudinally 2·75 mm., laterally 3·5 mm. Posterior valve longitudinally 2 mm., laterally 3·5 mm. Median valve longitudinally 3·5 mm., laterally 4 mm.

Comparisons.—*A. granostriatus* has narrower dorsal area, granules much more elongate and very shallow, the granules connected with one another radially by a slight raising of the floor, giving a streaky appearance under lateral lighting.

A. bednalli has also a narrower dorsal area, which is deeply, longitudinally grooved; in *bednalli* the granules are shorter and bluntly obovate, with flat to concave surfaces, the granules in *macrocystialis* are equally raised, but are longer, differently shaped, and often pointed. In the type of *gatliffi,* the dorsal area is more granulose and is longitudinally rugose, very distinct from the species under discussion, the sculpture of the other areas of *gatliffi* is more widely spaced and regular, the granules are attached at their bases, the anterior portion standing away from the shell, the granules themselves are shorter and broader, and the girdle in *gatliffi* is spongy, whereas in this species it is very spiculose.

Paratypes of A. macrocystialis, Ashby.—(a) Is greenish-buff, sculpture similar but the dorsal area is subcutaneously lined with white wavy lines, measures 9×4 mm. (b) Is buffish-brown, the dorsal area is marked with dotted lines and the shallow pitting is a little more marked, both this and the preceding show less of the spiculose character of the girdle than the larger specimens, this may be due to the breaking of the spicules, hair tufts are similar. (c) Two examples measuring, respectively, 10×5 and 8×4 mm., taken "off kelp" at the same locality, are both buff and granules white, the white dotted lining in the dorsal area is very marked, the sculpture is similar to type, the spiculose character of the girdle is conspicuous in the larger of the two.

Craspedochiton jaubertensis, n. sp.

Pl. xxxi., figs. 5*a*, 5*b*, 5*c*.

I am indebted to M. Nils H. J. Odhner, of Stockholm, for the example described hereunder. It was sent to me under the name *Craspedochiton laqueatus*, Sowerby, from which it seems distinct. It had been dredged off Cape Jaubert by Dr. E. Mjoberg, leader of the Swedish Scientific Expeditions of 1910-1913.

General Appearance.—The specimen is much curled and preserved in spirit; the girdle is very wide, occupying two-thirds of the width of the shell, and is ochreous-brown and non-spiculose and without hair tufts; the dorsal area is much raised and the diagonal rib very prominent.

Anterior Valve.—The whole of the upper portion of shell eroded, 5 radial folds or ribs corresponding with the slits, decorated with small, closely packed (usually separated), raised, squarish granules; towards the anterior margin the arrangement appears to be more or less concentric.

Posterior Valve.—Mucro raised and anterior, dorsal area broadly wedge-shape, smooth with a deep groove on either side, a raised diagonal fold from mucro laterally, posterior slope flat, tegmentum decorated with similar granules to the anterior valve, except that they are rather more convex.

Median Valve.—Dorsal area beaked, wedge-shape, the narrow central portion being divided from the elevated margin by a deep groove on either side, the outer ridges of this area slope steeply to the pleural area, giving to the whole dorsal area a highly raised appearance. The pleural area is separated from the lateral area by a narrow, highly raised, diagonal rib, which corresponds with the slit. The pleural area is decorated with longitudinal rows (I count 10) of spaced, raised, square to elongate, small, evenly distributed granules. The lateral area is similarly decorated, but the arrangement here is confused and the granules are larger.

Inside.—White, anterior valve 5 slits opposite the 5 radial ribs, teeth coarsely and irregularly dentate, propped on both sides. Posterior valve, insertion plate short, very coarsely dentate and propped, the number of slits difficult to determine, probably 8, sutural laminae well produced, sinus broad, anterior margin fairly straight. Median valve. Particulars are of No. 2 valve, insertion plate broad, eaves ill-defined, slits 1/1, festooned on either side as in genus *Callistochiton*, sutural laminae well produced, anterior margin straight, sinus broad, tegmentum bowed outwardly in centre.

Body.—The foot is very small, in curled specimen 7 mm. long, between the foot and the inside of girdle proper is a protruding spongy mass, on the outer side of which are numerous scales.

Measurements.—Example preserved in spirit total length 36 mm. by 22 mm., the anterior portion of the girdle measures 5 mm., and the posterior portion behind the tail valve 2 mm., of the total width of 22 mm., the shell measures only 7·5 mm., the rest being girdle. Median valve laterally 9 mm., longitudinally 6 mm. Posterior valve laterally 6 mm., longitudinally 4 mm. Anterior valve is incomplete but must have been fully 8 mm., laterally.

Girdle.—Colour ochreous-brown, very broad, occupying two-thirds of the total width, is asymmetrical, being broader in front than behind, encroaches on the valves at the sutures, is non-spiculose but covered with very minute corneous bodies.

Habitat.—Dredged in 70 feet off Cape Jaubert, 42 miles W.S.W., north-western Australia, by Dr. E. Mjoberg, 26th May, 1911.

In conclusion.—While in the British Museum in June, 1922, I compared this specimen with the type of *Craspedochiton laqueatus*, Sowerby. This latter was

from the Philippines; the species under review differs from it in the shape of the granules, which in *jaubertensis* are small and many elongate and narrow, whereas in *laqueatus* they are large, flat, and squamose; in *jaubertensis* the girdle is broader and encroaches more on the valves at the sutures. While certainly allied to *laqueatus*, we noted at the time that it certainly was a distinct species.

CORRECTIONS TO PAPER ON EXAMINATION OF TYPES IN PARIS.

Dr. Ed. Lamy, in Bull. Mus. Nat. Paris, 1923, pp. 260-265, points out that in the published results of Ashby's examination of the collections of Polyplacophora in the Paris Museum (Trans. Roy. Soc. S. Austr., xlvi., pp. 572-582), "some errors have crept in in the deciphering of the labels, with their faulty and illegible notes."

As pointed out in my introduction to that paper, owing to the limited time available, there was no opportunity of checking or correcting the records of observations, with the added difficulty, that both Dr. Lamy and the writer were unfamiliar with each other's language, it was impossible to avoid all mistakes. I am much indebted to Dr. Lamy for the following corrections:—

Page 578, in place of "Voy. de l'Astrolabe," read "Animaux sans Vertebres, 2nd Edition, Deshayes, vol. vii., p. 520."

Page 574, 13 lines from bottom, read "Dufresne M.S.S. in place of Dufrizai."

Page 581, Specimen (e), for "in spirit" read "dry."

DESCRIPTION OF PLATE XXXI.

(Reproduced from photographs by E. Ashby.)

Fig. 1.	*Acanthochiton*	*thackwayi,*	Ashby.	Type from Port Stephens.
„ 2.	„	„	„	Paratype from Port Stephens.
„ 3.	„	*macrocystialis,*	Ashby.	Type from Point Puer.
„ *3a.*	„	„	„	Type, anterior valve.
„ *3b.*	„	„	„	Type, median valve.
„ *3c.*	„	„	„	Type, tail valve (showing three slits in the insertion).
„ *4a.*	*Ischnochiton*	*tindalei,*	Ashby.	Type, anterior valve, from Groote Eylandt.
„ *4b.*	„	„	„	Type, median valve, from Groote Eylandt.
„ *4c.*	„	„	„	Type, tail valve, from Groote Eylandt.
„ *5a.*	*Craspedochiton*	*jaubertensis,*	Ashby.	Type, anterior valve (showing dentate and propped insertion), N.W. Australia.
„ *5b.*	„	„	„	Type, median valve, N.W. Australia.
„ *5c.*	„	„	„	Type, tail valve, N.W. Australia.

NOTES ON THE TYPES OF AUSTRALASIAN POLYPLACOPHORA IN THE BRITISH MUSEUM.

By Edwin Ashby, F.L.S., M.B.O.U.

[Read October 9, 1924.]

In June, 1922, I had the opportunity of examining the types in the collections in the British Museum, and my thanks are due to the authorities of that Museum for granting me facilities for this examination, to the staff and Mr. Tom Iredale for much assistance.

I had intended publishing these notes in connection with the proposed monograph on Australian Polyplacophora I had been working on for some years, but now Messrs. Iredale and Hull have commenced a similar work, it seems best to publish these notes without further delay. The types were compared with examples in the writer's collection.

Stenochiton juloides, Ad. and Ang. Type, from Gulf St. Vincent, South Australia. This is a typical specimen of South Australian shells of *Stenochiton (Chiton) longicymba,* Blainville.

Ischnochiton virgatus, Reeve. Type, from Port Lincoln, is similar to examples from the same locality in the writer's collection.

Ischnochiton (Chiton) decussatus, Reeve. Type, from Australia. This is the shell we used to know under this name in South Australia, but now know under the name *I. contractus,* Reeve. This latter was described by Reeve as having solitary granules in the lateral areas (sic disjunct); this character is so distinctive that one is compelled to concur with Iredale in considering Reeve's two species, *contractus* and *decussatus,* as conspecific, *contractus* having page precedence.

Ischnochiton castus (Cpr. MS.), published by Pilsbry. Type, from Swan River. This is the shell we know as *Ischnochiton contractus,* Reeve. The slight bridging in the pleural area does not commence at quite so early a stage as is the case in specimens from South Australia; the sculpture of the pleural area appears stronger.

Ischnochiton (Lepidopleurus) speciosus, Ad. and Ang. Type. This is the shell we know as *I. contractus,* Reeve.

Ischnochiton (Chiton) proteus, Reeve. Type, from Newcastle, New South Wales, collected by Dr. Dieffenbach. This is the shell we used to know under the name of *I. divergens,* Reeve, from Port Jackson.

Ischnochiton (Chiton) ustulatus, Reeve. Type. This is not an Australian species; in shape and sculpture it seems similar to the New Zealand species known as *Ischnochiton maorianus,* Iredale. The girdle scales are like that shell though a little less irregular than are the scales of examples from Doubtless Bay, with which I compared them. I consider that *Chiton ustulatus,* Reeve, is a rufous variety of the New Zealand *Ischnochiton maorianus,* Iredale.

Ischnochiton variegatus, Ad. and Ang. The type of this shell is not in the collections and seems to have been lost. The specimens sent by Bednall to the British Museum, under that name, include *I. lincolnensis,* Ashby, as well as other species.

Ischnochiton (Chiton) arbutum, Reeve. Type, from Port Essington, October, 1844. These agree with examples in my collection from North Queensland.

Ischnochiton crispus, Reeve. Type, collected by Dr. Dieffenbach at Newcastle, New South Wales. They are a subspecies of the shell from King Island which was described by Blainville under the name of *Chiton lineolatus;* of the nine examples, 1 is pink, 4 cream, and 4 yellowish-green, and correspond with specimens in my own collection from Port Jackson.

Ischnochiton (Chiton) carinulatus, Reeve. Type marked from Van Diemen's Land. It is not conspecific with any of the following *Ischnochitons: ptychius, tateanus,* or *falcatus.* Iredale considered it a South American shell.

Ischnochiton (Heterozona) cariosus (Cpr. MS.), Pilsbry. I saw the example that is believed to be the type; it is whitish, rather worn, and similar to South Australian specimens known under this name from Gulf St. Vincent, which I designate as the locality of the type.

Ischnochiton pallidus, Reeve, 1847.

Chiton pallidus, Reeve, Conch. Icon., t. 16, f. 92, March 1847. Non *Chiton contractus,* Reeve = *I. lineolatus,* Bl. of Iredale = *I. contractus,* Rv. of Sykes, Bednall, Torr, and others = *I. iredalei,* Dupuis = *I. iredalei,* Dupuis, of Ashby, Ashby and Hull and May = *I. lineolatus,* Bl. of Iredale and Hull. Sykes, Bednall, and Torr each followed Pilsbry in using the name *contractus,* Reeve, for this shell, and each of them considered *Chiton pallidus,* Reeve, to be a synonym. The recognising by Iredale that *contractus* and *decussatus,* both of Reeve, were conspecific, led Dupuis to give the name of *iredalei* to this shell, overlooking the earlier name of *pallidus,* Reeve.

Reeve's type is a very worn specimen of the shell described by Dupuis under the name *iredalei,* from a specimen given to him by myself from Gulf St. Vincent, in South Australia, which is therefore the type locality, not Flinders Island, as designated by Iredale and Hull. As no locality is given for Reeve's type, I designate Gulf St. Vincent as the type locality.

Iredale and Hull, in the Aust. Zool., vol. 3, pt. 6, pp. 232, 233, again discuss this shell under the name of *I. lineolatus,* Blainville. The position taken up first by Iredale, and now by Iredale and Hull, is in opposition to the opinions expressed by Dupuis, Dr. Lamy, and myself, each of whom has carefully examined the collections in Paris, and Iredale and Hull's attitude is quite unsupported by facts.

When I was in Paris in July, 1922, Dr. Lamy was good enough to assemble for me the whole of their collections of Polyplacophora, and, further, we assembled into one block the whole of the Australasian material, both dry and spirit-preserved specimens.

(1) In the whole of these collections I did not see a single specimen of the *I. pallidus,* Reeve, syn. *I. iredalei,* Dupuis, which is the shell Iredale and Hull would have us consider to be *lineolatus,* Blainville.

(2) Blainville distinctly states that his type of *lineolatus* came from "Ile King" and was collected by Peron and Lesueur.

(3) There are several examples of the shell we know as the southern form of *I. crispus,* Reeve, on the tablets marked as from "Ile King," collected by Peron and Lesueur.

(4) The specimen mounted on one of these tablets, which has been recognised by Dupuis, Lamy, and the writer as Blainville's type of *lineolatus,* is one of these examples and exactly agrees with Blainville's description, both in colour, sculpture, and markings, the numerous striae mentioned being most apparent on this specimen.

(5) M. Dupuis gave me four examples that had been collected on King Island by Peron and Lesueur; three of them are the southern form of *crispus,* Reeve, the other is *Ischnochiton (Heterozona) subviridis,* Iredale and May;

also in faded ink on the inside of the shell of one of the former are the words "Ile King."

The position taken by Iredale and Hull appears to me quite untenable; they would have us recognise as Blainville's type of *lineolatus*, which Blainville states came from King Island, a species which is unrepresented in the Paris collections. Further, they would have us consider that the shells, which Lamy, Dupuis, and Ashby recognise as Blainville's *lineolatus*, and which specimens are clearly marked (in some cases evidently in the hand-writing of one of the collectors) as coming from King Island, are not that shell at all, but another species described by Blainville under the name *elongatus*, but of which the locality was quite unknown to Blainville.

Iredale and Hull then would have us believe that these specimens that are so clearly marked as from King Island did not come from that place at all, but came from an entirely different locality, which they designate as Kangaroo Island, in the State of South Australia, a contention that is unsupported by the smallest fact or probability.

Note.—If Messrs. Iredale and Hull are desirous of recognising Blainville's *elongatus* in some shell collected by Peron and Lesueur that is still preserved in the Paris Museum, then, as far as the description is concerned, they could well fix upon *Ischnochiton (Heterozona) subviridis*, Iredale and May, of which there are several examples in the collection. The one objection to this course is that Blainville gives no locality save "Australian Seas" for his *elongatus*. I personally agree with Pilsbry that the description of *elongatus* is insufficient for determination. But if Iredale and Hull still desire to recognise *elongatus*, Blainville, as a known species, I designate *I. subviridis*, Iredale and May, as the only unrecognised shell in the collections that I saw that will fit the description.

The specimens referable to this species, that I examined there, are half-grown shells that need cleaning, and are therefore difficult of determination. When examining them I came to the conclusion that Blainville had probably considered them conspecific with his *lineolatus* (the southern form of *crispus*). I still think this is so, but there is still the possibility that he may have named his *elongatus* from a specimen of *subviridis* from which the locality tablet had become separated. The shell Iredale and Hull call *Ischnochiton elongatus*, Blainville, is, without doubt, as has been amply shown, *Ischnochiton (Chiton) lineolatus*, Blainville.

Callistochiton antiquus, Reeve. Type, from Australia. This is certainly conspecific with specimens from Port Jackson in my own collection with which I compared them.

Plaxiphora petholata, var. *modesta* (Cpr. MS.). Type. This is the smooth form we have commonly called *glauca*, Quoy and Gaimard.

Plaxiphora petholata, var. *tasmanica* (Cpr. MS.). Type. This is a very highly sculptured form with double ribs, almost like *conspersa* from Port Lincoln, but we have the same double-ribbed form from Gulf St. Vincent; the type is said to have come from Tasmania.

Plaxiphora (Chaetopleura) conspersa, Ad. and Ang. Type, from Port Lincoln, 26th Oct., 1870. This is the highly sculptured form of *Plaxiphora* collected by the writer at the same locality.

Frembleya egregia, Adams. Type is supposed to have come from Australia, but is undoubtedly the New Zealand shell known under this name.

Spongiochiton productus, Carpenter. Type, marked as from New Zealand, but is considered to have come from Africa. My notes read, "Is something like

Craspedochiton laqueatus, Sowerby, but has an irregular girdle like *Loricella* or *Placiphorella.*" The dorsal area is worn but probably had two deep longitudinal sulci bordering that area, which is narrow and strongly pinnatifid. The lateral and pleural areas in *productus* are closely covered with very large rounded granules; the diagonal rib is only indicated by a wave.

Acanthochiton carinatus, Ad. and Ang. Type, described as from Port Jackson. This is a large broad shell, decorated with closely packed granules and having a narrow, smooth, dorsal area. *Note.*—Iredale believes that it is the British shell *A. descrepans.*

Acanthochiton asbestoides, Smith. Type, from Flinders Island, Tasmania. Is conspecific with specimens in my collection from southern Tasmania, and from Wilson's Promontory, in Victoria.

Acanthochiton (Notoplax) speciosus, Adams. Type, from Tasmania. This is the shell we know under the same name from South Australia; the coarser radial granules are present in the anterior valve.

Acanthochiton (Notoplax) costatus, Ad. and Ang. Type. In one example the diagonal rib is furnished with small granules, in the other these granules are long and coalesced. In both, the radial ribs in the anterior valves are composed of long, coalesced granules. I have similar specimens from New South Wales.

Choriplax grayi, Ad. and Ang. Type, from Port Jackson. This differs from *Choriplax pattisoni,* Ashby, in that it is very much longer and narrower in proportion, it is more arched than *pattisoni,* and the articulamentum is barely joined across the central line, whereas in *pattisoni,* the heart-shaped tegmentum is placed well back from the edge of the articulamentum.

Whereas I described *Choriplax pattisoni* as a subspecies of *grayi,* the examination of the unique specimen of the latter in the British Museum determines me to recognise it as a distinct species. We have, therefore, this interesting fact, that this remarkable genus is only known from two specimens, one collected by Angas at Port Jackson in 1864, and the other collected by Pattison at Cape Banks, in South Australia, in 1921, and that these unique specimens represent two distinct species. In the paper accompanying the description of *C. pattisoni* (Trans. Roy. Soc. S. Austr., vol. xlv., 1921, pp. 136-142, pl. ix.) the writer shows that the true place in the Natural Taxis of this genus is near to the North American genus *Cryptochiton.* Instead of the insertion plates being absent in *Choriplax,* as was thought by earlier writers, they are highly developed, the slits have become obsolete, an extension of the girdle mantle covering the whole of the upper shell, except the heart-shaped fragment of the subobsolete tegmentum. In *Cryptochiton* we have the same highly developed insertion plates, the slits have become subobsolete, the tegmentum has become completely obsolete, and a similar extension of the girdle mantle covers the whole of the upper shell. It is not necessary to assume that the one genus has been derived through the other, but I consider that both are specialised forms derived from an Acanthoid stock, and would suggest that the extraordinary modifications of structure that are common to both have been brought about independently along parallel lines through a process of adaptation to very similar ecological conditions.

Chiton (Rhyssoplax) aureo-maculata, Bednall and Matthews. The type was lost; the specimen sent by the authors as being the same as the type is a variety of *tricostalis,* Pilsbry, and I consider that *aureo-maculata* is only a colour variety of that species.

Sypharochiton (Chiton) sinclairi, Gray. Type from New Zealand sent by Dr. Sinclair and figured in "Voyage of Erebus and Terror." The type is similar

to shells in my collection from Doubtless Bay, New Zealand, except a little faded. I could not separate them from some of the smooth forms from Tasmania. Iredale informed me that in New Zealand the highly sculptured form never varies into *sinclairi.* I consider that the forms grade into one another in Tasmania, but the *sinclairi* from the Dominion are a little more carinated than most of the Tasmanian shells, but in selected examples they can almost, if not quite, be paired. Iredale also stated that the girdle scales in *sinclairi* are always polished.

Amaurochiton glaucus, Gray. Type. This is undoubtedly the shell we know under this name from New Zealand and Hobart, Tasmania.

Lorica volvox, Reeve. Probably the type, but is now marked *cimolea,* from Sydney. It agrees with the figure in "Conch. Icon., Reeve," and is a typical Port Jackson shell which we know under the same name.

Lorica cimolea, Reeve. Probably the type. It corresponds with the shells we know under this name from South Australia.

Loricella angasi, H. Adams. Type. This is evidently a washed shore shell, showing some of the finger-like processes at the girdle margin, but all "spear-head" spicules are missing.

Acanthopleura (Chiton) cumminghami, Reeve. Type. This shell is said to have come from Australia, but it is not the shell known as *Acanthopleura gemmata,* Blainville; has a different insertion plate in the tail valve, is of the *Amphitomura* type, and cannot be considered an Australian shell.

Tonicia (Lucilina) truncata, Sowerby. Type, 1841. The sculpture of the pleural area is very similar to *delecta,* Thiele, only smoother; there is no radial ribbing in the lateral area, the broken diagonal rib in the median valves is duplicated at the posterior margin, the trough between these two ribs being densely sprinkled with eye spots.

Tonicia (Lucilina) carpenteri, Angas, 1867. Type, said to be from Port Jackson; the pleural area is the same as *delecta* and the lateral area shows ribbing.

Tonicia (Lucilina) fortilirata, Reeve, 1847. Type, from Torres Strait. Both lateral and pleural areas are similarly sculptured to *delecta,* but the sculpture is a little stronger.

Tonicia picata, Reeve, now *shirleyi,* Iredale, the name *picata* having been preoccupied. This is a smoother form than the preceding and appears conspecific with *truncata,* Sowb., but as the latter came from the Philippines and *shirleyi* from Queensland, it may be preferred to retain *shirleyi* as a separate race.

Tonicia jugosulcata (Cpr. MS.). Type. This specimen has not a truncated tail valve and belongs to a different group to the foregoing; it is alleged to have come from Tasmania, but the locality is probably incorrect, is most likely non-Australian.

In conclusion.—We find that the northern forms of *Tonicia* very variable, and it is quite possible that there exist intermediate grades from the highly sculptured *fortulirata* through *delecta, carpenteri, shirleyi* to *truncata,* all having a similar truncated tail valve, but for the present it seems desirable to recognise two Australian forms of this type:—

(1) *Tonicia (Lucilina) fortulirata,* Reeve, 1847 (Conch. Icon., pl. 18, f. 112), with syn. *carpenteri,* Angas, 1867, and syn. *delecta,* Thiele, 1911.

(2) *Tonicia (Lucilina) truncata, shirleyi,* Iredale, syn. *picata,* Reeve. No. 1 representing the highly sculptured varieties and No. 2 the smoother, but both groups having similarly truncated tail valves.

The third recognised Australian *Tonicia* is *hullianus,* Torr, which is a distinct type, up till the present only known from the type example collected by Dr. Torr in south-western Australia, and a second specimen collected by the writer in the same locality.

Onithochiton (Chiton) rugulosus, Angas, 1867. Type, from Port Jackson. This is conspecific with examples in my collection from the same locality and was described by Gould, in 1846, under the name *quercinus.*

Onithochiton (Chiton) incei, Reeve. Type, from Torres Strait. This also in conspecific with shells from Port Jackson, known as *Onithochiton quercinus,* Gould.

Onithochiton (Chiton) lyelli, Sowerby, 1832. Type was from Pitcairn Island. Although it is near *quercinus,* Gould, it appears a distinct species. I saw specimens from Perth, presented by Gould; these are evidently Thiele's *scholvieni.*

Sclerochiton miles and other types have been dealt with in earlier papers by the writer.

ABSTRACT OF PROCEEDINGS

OF THE

ROYAL SOCIETY OF SOUTH AUSTRALIA

(Incorporated)

FOR THE YEAR NOVEMBER 1, 1923, TO OCTOBER 31, 1924.

ORDINARY MEETING, NOVEMBER 8, 1923.

THE PRESIDENT (R. H. Pulleine, M.B.) in the chair.

PAPERS.—"The Ecology of the Eucalyptus Forests of the Mount Lofty Ranges," by R. S. ADAMSON, M.A., B.Sc., and Professor T. G. B. OSBORN, D.Sc.; "Résumé of H. R. Marston's report on his researches on the Azine and Azonium Precipitates of the Proteolytic Enzyime Trypsin," communicated by Professor T. B. Robertson. [See vol. xlvii., p. 400.]

EXHIBITS.—Mr. A. M. LEA exhibited the following insects:—(1) A number taken in ants' nests; (2) A collection made by Professor F. Wood Jones; (3) Moths from Fiji very destructive to cocoanuts.

ORDINARY MEETING, APRIL 10, 1924.

THE PRESIDENT (R. H. Pulleine, M.B.) in the chair.

RESIGNATION.—Mr. A. M. Lea resigned his position on the Council, as he was leaving the State for a year to undertake an investigation for the Fijian Government. The resignation was accepted, and Sir Joseph Verco, F.R.C.S., was elected in his stead.

INVITATIONS.—From Royal Society, London, inviting our Fellows to attend any of its meetings during this year without introduction; also from the Franklin Institute asking for a representative to attend its Centenary celebrations next September. The PRESIDENT reported that during the recess we had been asked to send a representative to the Centenary in May of the Linnaean Society, Normandy, and of the Society of Antiquaries, Normandy, and to the seven-hundredth anniversary of the University of Naples; also to the Jubilee of the Physical Society, London, in March. To the last of these the Council had appointed our Hon. Fellow, Professor Sir W. H. Bragg, as our representative.

FAUNA AND FLORA BOARD.—The PRESIDENT reported that at the invitation of the Government the Council had nominated for appointment on this Board Mr. Edgar R. Waite, F.L.S., C.M.Z.S., in place of Capt. S. A. White, C.M.B.O.U., who retired by effluxion of time.

PRESENTATION TO EDITOR.—The PRESIDENT read a letter from Sir Joseph C. Verco referring to the eminent service rendered to the Society by Professor Walter Howchin, F.G.S., who had for the last 23 consecutive years, and for seven previous years, acted as Honorary Editor of the Society's publications in such a way as to bring great credit to himself and to the Society. In slight recognition of his work he handed to the Professor a cheque which had been subscribed by Fellows of the Society. Professor RENNIE and Dr. R. S. ROGERS endorsed the remarks of the President. Professor HOWCHIN suitably responded.

PAPERS.—"Notes on Australian Crustacea, No. II., Family Gnathiidae," by HERBERT M. HALE; "Studies in Australian Aquatic Hemiptera: No. IV., The Corixid Genus Diaprepocoris," by HERBERT M. HALE; "Chalcidoidea and Proctotrupoidea from Lord Howe and Norfolk Islands, with descriptions of New Genera and Species," by ALAN P. DODD; "The Flora and Fauna of Nuyts Archipelago and the Investigator Group: No. 15. The Pearson Island Rat and the Flinders Island Wallaby," by F. WOOD JONES, D.Sc., etc.

EXHIBITS.—Mr. E. R. WAITE exhibited an example of *Dactylosargus arctidens,* a cirrhitoid fish not previously recorded from South Australia. Mr. N. B. TINDALE showed a collection of insects taken on Flinders Island by Professor F. Wood Jones and Dr. T. D. Campbell. A small brachelytrous cockroach, which is also probably new, and the blue butterfly, *Zizinal labradus.* Dr. R. H. PULLEINE exhibited four skulls of Tasmanian aborigines collected on his recent tour.

ORDINARY MEETING, MAY 8, 1924.

THE PRESIDENT (R. H. Pulleine, M.B.) in the chair.

ELECTIONS.—J. W. Browne, B.A., M.B., B.Ch.; C. T. Ch. de Crespigny, M.D., D.Sc.; P. S. Messent, M.B., B.S.; Prof. A. J. Perkins; P. W. Rice, M.B., B.S.; and Wallace Sandford, as Fellows.

NOMINATIONS.—R. W. Segnit, B.A., B.Sc.; P. S. Hossfeld; Fred. N. Simpson; and W. R. Cavenagh-Mainwaring, M.B., Ch.B., were nominated as Fellows.

The PRESIDENT reported that he had listened-in on May 6 to the annual address given by the President of the Royal Society of N.S. Wales in Sydney (Mr. R. H. Cambage, F.L.S.) on "Liquid Fuels." The President went to the Adelaide Radio Company's station at Millswood, where the address was heard very distinctly. It was resolved that letters of thanks be forwarded to those concerned. Messrs. W. J. Kimber and W. H. Baker were appointed delegates to the Council of the Australasian Association for the Advancement of Science Adelaide meeting, August 25-31 (inclusive), 1924.

PAPERS.—"Australian Anobiides," by A. M. LEA, F.E.S.; "*Blackburniella,* nov. nom. for *Thanasimomorpha,* Blackb.," by E. A. CHAPIN, Ph.D., communicated by A. H. Elston, F.E.S.; "Flora and Fauna of Nuyts Archipelago and the Investigator Group: No. 16, The Crustacea," by H. M. HALE.

EXHIBITS.—Mr. W. J. KIMBER exhibited a number of shells and fossils found by him at Blanche Point, Port Willunga. Mr. E. R. WAITE exhibited, from the Museum, specimens of the Dummy Mourning Caps of the Murray River natives. Widows' caps have long been known, but objects now known to be dummies have not been previously identified as such. These were brought to the graves by relatives or friends and deposited one by one after the widow had placed her cap on the burial ground. Dr. R. H. PULLEINE showed a cylindro-conical stone from Arcoona Station, near Kimba, establishing a new western range for these aboriginal objects. Also specimens of a spider, *Ectatostica troglodites,* from the Mole River caves, W.A., two and a half inches long, and almost the largest in Australia.

ORDINARY MEETING, JUNE 12, 1924.

THE PRESIDENT (R. H. Pulleine, M.B.) in the chair.

ELECTIONS.—R. W. Segnit, B.A., B.Sc.; P. S. Hossfeld; F. N. Simpson; and W. R. Cavenagh-Mainwaring, M.B., Ch.B., as Fellows.

NOMINATIONS.—C. A. S. Hawker; C. Pearce; A. J. Morison; and Miss M. T. P. Roeger, as Fellows.

THE LATE HON. SECRETARY.—Dr. R. S. ROGERS, M.A., read an obituary notice of the late Hon. Secretary, which will be printed in the Transactions for 1924.

It was resolved that the election of a Hon. Secretary be postponed until the Annual Meeting, and that Mr. E. H. Ising be Acting Hon. Sec. until then.

PAPERS.—"Chiton Fauna (Polyplacophora) of Port Stephens, N.S. Wales," by E. ASHBY, F.L.S., M.B.O.U.; "Pouch Embryos of Marsupials: No. 8, *Dendrolagus matschiei*," by F. WOOD JONES, D.Sc., etc.; "On the Discovery of Supposed Aboriginal Remains near Cornwall, Tasmania," by R. H. PULLEINE, M.B.; "An Unrecorded Type of Aboriginal Stone Object," by T. D. CAMPBELL, D.D.Sc.

EXHIBITS.—Chitons obtained at Port Stephens by Mr. ASHBY. Paintings of native flowers from Port Stephens executed by Miss A. Ashby. Peculiar sponges of the genus *Thorecta* obtained by Mrs. C. Pearce at Port Willunga. A living blind snake *(Typhlops australis)* shown by Mr. E. R. WAITE, who stated that the thorn-like scale at the end of the tail was for facilitating a passage through the soil. Sir DOUGLAS MAWSON showed a field microscope devised by Dr. Goldschmidt, of Christiana University, portable, light, and of high quality. Dr. CLELAND exhibited a live python, 5 feet long, harmless and docile, obtained at Cordillo Downs; also two cylindrical aboriginal stones, one 21¾ inches long, from near Tinga Tingana, obtained through Mr. Patterson. Rev. J. C. JENNISON showed some rope made from the bark of a tree called by the natives of Elcho Island *balgoro,* known as the sandpaper tree. Prof. T. HARVEY JOHNSTON exhibited, on behalf of Dr. Cleland, a freshwater sponge from 80 miles north of Cooper Creek, tape worms from the dingo, and black sand-flies.

ORDINARY MEETING, JULY 17, 1924.

THE PRESIDENT (R. H. Pulleine, M.B.) in the chair.

ELECTIONS.—C. A. S. Hawker; C. Pearce; A. J. Morison; and Miss M. T. P. Roeger, as Fellows.

NOMINATIONS.—F. R. Guinnane and Wm. D. Walker, B.Sc., as Fellows.

PAPERS.—"External Characters of Pouch Embryos of Marsupials: No. 9, *Phascolomys tasmaniensis,*" by F. WOOD JONES, D.Sc., etc.; "Some New Records of Fungi for South Australia, Part 3," by GEOFFREY SAMUEL, B.Sc., etc.

EXHIBITS.—A volume (No. 2) of some South Australian structural geology photographs, presented to the Society by Mr. J. Greenlees, c/o Amalgamated Zinc Co., Broken Hill. Dr. T. D. CAMPBELL showed a series of marked stones from Normanville, possibly indicating glacial action. Dr. PULLEINE exhibited two stones from Normanville, also one hand axe and three choppers from Tasmania. Dr. A. M. MORGAN showed a slate object from Normanville, also a stone axe and rough chopper from near Robe. Mr. E. R. WAITE, on behalf of the Museum, exhibited a series of Australian River tortoises, and drew attention to certain peculiarities in their structure, features found only in another genus from South America. Professor W. HOWCHIN exhibited the internal cast of a large fossil gasteropod shell, probably *Pleurotomaria,* obtained from the older marine Tertiary of South Australia, which showed that during the life of the mollusc the shell had been riddled by the small boring sponge *Cliona,* which is easily recognised from its pin-shaped spicules. Professor Howchin also showed what were equivalent to money tokens as used in the islands of New Guinea; low values are represented in small perforated circular discs, made from shells, 28 of which, according to the Rev. J. R. Andrew (who presented them to him)

represent a value of about 7s. 6d.; larger values, by highly finished and polished stone implements, not used as tools, one of which, equal to about 30s., was shown. This is an interesting example of primitive forms of exchange; it is not barter, which is an exchange of commodities, but a conventional system of exchange based on the equivalent of work represented in the objects used for payment.

Ordinary Meeting, August 14, 1924.

The President (R. H. Pulleine, M.B.) in the chair.

Elections.—F. R. Guinnane and W. D. Walker, B.Sc., as Fellows.

Paper.—"On the Specialized Incisor Teeth of some of the Didactylous Marsupials," by Professor F. Wood Jones, D.Sc., etc.

Exhibits.—Dr. Lendon exhibited two pieces of pottery made by the so-called cave-dwellers at Atalaya, in the Grand Canary, who are said to be a remnant of the aborigines, the Guanches; also fragments of pottery from the excavations at Knossos, in Crete, on the site of the Palace of Minos. Mr. W. J. Kimber showed, from Port Lincoln, a series of *Scapha fulgetrum,* South Australia's largest volute. Mr. E. Ashby exhibited a large collection of Central and South American Trogonidae, which are distinguished from the Picarian families chiefly by the structure of the tendons of the foot. Mr. P. S. Hossfeld showed several specimens from Ardrossan illustrating the variety of rocks in which Turritellae are found, and also one of silicified wood covered with small quartz crystals. Mr. H. M. Hale exhibited the common "yabbie," *Parachaeraps bicarinatus,* one specimen showing adaptation of colour to environment, another carrying young beneath the abdomen (not hitherto recorded), and a third showing malformed chelae, the result of injury received soon after moulting. Dr. T. D. Campbell showed a number of worked stones from the native camp near the rifle butts at Fulham, chiefly scrapers and miniature chipped knives. Dr. Pulleine showed a pod of sea island cotton from the Northern Territory, and a cylindro-conical stone from Menindie, N.S. Wales. Mr. N. B. Tindale exhibited some nodules of calcified sand found at Ceduna, West Coast, together with recent ones containing the remains of beetles, showing that the nodules are the calcified pupal cases of the weevil, *Leptops duponti.*

Informal Meeting, September 11, 1924.

The President (R. H. Pulleine, M.B.) in the chair.

As three full days' notice had not been given, this could not be an ordinary meeting of the Royal Society. It was resolved that the Papers be read and laid on the table, and be formally accepted as read at the next meeting.

Nomination.—I. G. Symons, as Fellow.

Papers.—"South Australian Expedition to Observe the Total Solar Eclipse on September 21, 1922, at Cordillo Downs, far N.E. of South Australia," by Kerr Grant, M.Sc., and G. F. Dodwell; "Revision of the Australian Elateridae (Coleoptera), Part I.," by A. H. Elston, F.E.S.; "The Relations between Distribution, Structure, and Transpiration of Arid South Australian Plants," by J. G. Wood, B.Sc.; "Notes on Australian Crustacea, No. 3," by H. M. Hale; "New Genera and Species of Australian Stone-flies," by R. J. Tillyard, M.A., D.Sc., etc., communicated by E. R. Waite, F.L.S.

Exhibits.—Mr. E. R. Waite, on behalf of the S.A. Museum, showed the cast of an egg of the Deinosaur from Mongolia, sent by the American Museum of Natural History; also a skeleton of the Loggerhead Turtle *(Thalassochelys caretta)* from Port Noarlunga, a new record for South Australia, and a skeleton of a Green Turtle *(Chelone mydas)* for comparison.

Annual Meeting, October 9, 1924.

The President (R. H. Pulleine, M.B.) in the chair.

Election.—I. G. Symons, as Fellow.

The Annual Report and Financial Statement were read and adopted.

It was moved —"That a motion be placed on record that the position of President be held for one year only." An amendment was carried—"That consideration of the matter be deferred for twelve months."

Election of Officers.—The following officers were elected for 1924-25:— *President,* Prof. Sir Douglas Mawson, D.Sc., F.R.S., etc.; *Vice-Presidents,* R. H. Pulleine, M.B., and Prof. T. G. B. Osborn, D.Sc.; *Members of Council,* Prof. Wood Jones. D.Sc., etc., Prof. J. B. Cleland, M.D., and L. Keith Ward; *Hon. Treasurer,* B. S. Roach; *Hon. Secretary,* C. Fenner, D.Sc.

Papers.—"The Relation of Climate to the Spread of Prickly Pear," by Professor T. Harvey Johnston, M.A., D.Sc.; "Further Discoveries of Glacial Features near Hallett's Cove," by Professor Walter Howchin, F.G.S.; "Additions to the Flora of South Australia, No. 22," by J. M. Black; "Australian Fungi, Notes and Descriptions, No. 5," by Professor J. B. Cleland, M.D.; "Notes on the Types of Australian Polyplacophora in the British Museum," by Edwin Ashby, F.L.S.; "Further Notes on Australian Polyplacophora, with descriptions of Three New Species," by Edwin Ashby, F.L.S.; "On a Notable Monazite-bearing Pegmatite, near Normanville," by R. Grenfell Thomas, B.Sc.; "Anthropometric and Descriptive Observations on some South Australian Aboriginals," by Professor F. Wood Jones, D.Sc., etc., and Dr. T. D. Campbell.

ANNUAL REPORT

for Year ended September 30, 1924.

During the year many important contributions in Natural Science were placed before the Society. In Botany, by Professor Osborn, J. M. Black, J. G. Wood, and E. H. Ising; in Mammalogy, by Professor Wood Jones; in Entomology, by A. M. Lea, H. M. Hale, and A. H. Elston; in Anthropology, by Professor Wood Jones, Dr. T. D. Campbell, and Dr. R. H. Pulleine. Professor Howchin and Mr. R. G. Thomas presented papers on Geological features; Mr. E. Ashby continued his contributions on Polyplacophora; and Dr. Cleland on Fungi. Professor Kerr Grant gave an interesting account of the Eclipse Expedition to Cordillo Downs. A great number of interesting exhibits were tabled during the year.

The Library received two important donations during the year, one being a nearly complete set of Proceedings, presented by the Royal Geographical Society; and a splendid reference map of South Australia, presented by the Minister of Crown Lands (Hon. G. R. Laffer), through the Surveyor-General.

Nothing has so far been done to provide additional shelving for our expanding Library, and as all available accommodation is taken up, this will require attention during the coming year. Fully 50 per cent. more shelving is urgently required.

Messrs. W. H. Baker and W. J. Kimber were elected as Delegates from our Society to the Council of the Australasian Association for the Advancement of Science, at the Adelaide meeting, in August of this year.

Sir Joseph Verco, on his return from abroad, was elected to the Council in the place of Mr. A. M. Lea, who resigned in April owing to absence from the State.

The death of Mr. Walter Rutt, C.E., for many years our invaluable Secretary and the oldest Fellow of the Society, occurred in May, 1924. Dr. R. S. Rogers is contributing a biographical notice of the deceased in this volume. Another Fellow, Dr. Melville Birks, elected in 1921, passed away during the year.

The attendances at meetings of Council have been as follows:—Prof. Howchin and Mr. Roach, 9; Prof. Wood Jones, Dr. Rogers, and Dr. Pulleine, 7; Prof. Osborn and Mr. Waite, 6; Profs. Cleland and Robertson, 5; Sir Joseph Verco and Sir Douglas Mawson, 4; the late Hon. Secretary, 4; Mr. Lea, 2.

Our present membership comprises 7 Honorary Fellows, 4 Corresponding Members, and 109 Fellows.

ROBERT PULLEINE, *President.*

E. H. ISING, *Acting Hon. Secretary.*

ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

Revenue and Expenditure for 1923-24.

	£	s.	d.	£	s.	d.
To Balance, October 1, 1923				556	1	9
„ Subscriptions—						
Royal Society	109	4	0			
Field Naturalists' Section	52	5	3			
				161	9	3
„ Grants from Government—						
On Subscriptions	139	6	5			
For Printing Reports and Scientific Investigations	150	0	0			
				289	6	5
„ Receipts for use of Room by other Societies	5	13	6			
„ Sale of Publications	3	19	7			
				9	13	1
„ Savings Bank Interest	10	15	3			
„ Interest transferred from Endowment Fund	178	18	7			
				189	13	10
				£1,206	4	4

	£	s.	d.	£	s.	d.
By Transactions—						
Printing	361	19	0			
Illustrating	226	6	1			
Publishing	14	11	1			
				602	16	2
„ Grant—						
Field Naturalists' Section				50	0	0
„ Library—						
Librarian	37	8	9			
Book-binding	9	11	6			
				47	0	3
„ Sundries—						
Cleaning and Lighting	9	2	9			
Printing, Postages, Stationery	19	2	8			
Insurance	6	15	0			
Advertising	7	8	5			
Fee for filing Rules	0	5	0			
				42	13	10
„ Balance September 30, 1924—						
Savings Bank of S.A.	364	11	5			
Bank of Australasia	98	18	8			
Cash in Hand	0	4	0			
				463	14	1
				£1,206	4	4

Audited and found correct,

W. CHAMPION HACKETT, } Hon.
HOWARD WHITBREAD, } Auditors.

B. S. ROACH, Hon. Treasurer.

Adelaide, October 6, 1924.

ENDOWMENT FUND.

(Capital £3,844 6s. 10d.)

	£	s.	d.	£	s.	d.
1923—October 1.						
To Balance, S.A. Government Stock	3,839	18	9			
Savings Bank	4	8	1			
				3,844	6	10
„ Interest received on Govt. Stock	178	15	0			
Savings Bank	0	3	7			
				178	18	7
				£4,023	5	5

	£	s.	d.	£	s.	d.
1924—September 30.						
By £2,000 S.A. Govt. Stock at 3¾ per cent.	1,997	10	0			
„ £800 S.A. Govt. Stock at 5½ per cent. ..	800	0	0			
„ £500 S.A. Govt. Consolidated 3 per cent. Stock	292	8	9			
„ £100 S.A. Govt. Stock at 5 per cent. ..	100	0	0			
„ £650 S.A. Govt. Stock at 5½ per cent. ..	650	0	0			
„ Savings Bank Account	4	8	1			
				3,844	6	10
„ Revenue Account				178	18	7
				£4,023	5	5

Audited and found correct.

W. CHAMPION HACKETT, } Hon.
HOWARD WHITBREAD, } Auditors.

B. S. ROACH, Hon. Treasurer.

Adelaide, October 6, 1924.

DONATIONS TO THE LIBRARY

FOR THE YEAR ENDED SEPTEMBER 30, 1924.

TRANSACTIONS, JOURNALS, REPORTS, ETC.,
presented by the respective governments, societies, and editors.

AUSTRALIA.

AUSTRALASIAN ANTARCTIC EXPEDITION, 1911-14. Scientific reports, ser. C, v. 3, pt. 3; 6, pt. 6. Syd. 1923.
AUSTRALASIAN ASSOCIATION FOR ADVANCEMENT OF SCIENCE. Rep., v. 16.
AUSTRALIAN INSTITUTE OF MINING. Proc., no. 49-52. Melb. 1923.
AUSTRALIAN JOURNAL OF EXPERIMENTAL BIOLOGY, no. 1-3. Adel. 1924.
AUSTRALIA. *Census and Statistics.* Yearbook, no. 16. Melb. 1923.
——— *Dept. of Health.* Service publication, no. 2-6, 8. Melb.
——— *Fisheries.* Bull., v. 5, pt. 3. Melb.
——— *Institute of Science and Industry.* Bull. 26. Report 2.
——— *National Research Council.* Sci. abstracts, v. 2, no. 4; 3, no. 1-3.
——— Power resources of the Commonwealth. Syd. 1924.

SOUTH AUSTRALIA.

ADELAIDE UNIVERSITY. *Animal Products.* Report 3. 1923.
PUBLIC LIBRARY, MUSEUM, AND ART GALLERY OF S.A. Report, 1923.
——— Records of S.A. Museum, v. 2, no. 4. Adel. 1924.
SOUTH AUSTRALIA. *Dept. of Mines.* Review, no. 38-39. Adel. 1923.
——— *Geological Survey.* Report, 1922. Adel.
——— *Woods and Forests.* Report, 1922-23. Adel.
SOUTH AUSTRALIAN NATURALIST, v. 5, no. 1-4. Adel. 1923-24.
SOUTH AUSTRALIAN ORNITHOLOGIST, v. 7, pt. 3-7. Adel. 1923-24.
SOUTH AUSTRALIAN SCHOOL OF MINES. Report, 1923. Adel.

NEW SOUTH WALES.

AUSTRALIAN MUSEUM. Museum magazine, v. 1, no. 10; 2, no. 1-3.
——— Records, v. 13, no. 7; 14, no. 2-3. Report, 1923. Syd.
LINNAEAN SOCIETY OF N.S.W. Proc., v. 48, pt. 3; 49, pt. 1-2. Syd.
MAIDEN, J. H. Critical revision of the genus Eucalyptus, pt. 62.
——— Forest flora of N.S.W., v. 8, pt. 4-6. Syd. 1923-24.
NEW SOUTH WALES. *Board of Fisheries.* Report, 1922. Syd.
——— *Botanic Gardens.* Report, 1921-22. Syd.
——— *Dept. of Agriculture.* Gazette, v. 34, pt. 10-12; 35, pt. 1-9.
——— *Dept. of Mines.* Report, 1923. Syd. 1924.
——— *Geological Survey.* Bull., no. 4-5, 8, suppl. Syd. 1923.
——— *Public Library.* Report, 1922-23. Syd.
ROYAL SOCIETY OF N.S.W. Journ., v. 56-57. 1922-23. Syd.
ROYAL ZOOLOGICAL SOCIETY OF N.S.W. Austral. zool., v. 1-2; 3, pt. 1-6.
TECHNOLOGICAL MUSEUM. Bull., no. 6, 8-9. Syd. 1923-24.

QUEENSLAND.

QUEENSLAND. *Dept. of Agriculture.* Journ., v. 20-21; 22, pt. 1-3.
——— *Geological Survey.* Publications, no. 274. Brisb. 1923.
QUEENSLAND MUSEUM. Mem., v. 8, pt. 1. Brisb. 1924.
ROYAL SOCIETY OF QUEENSLAND. Proc., v. 35. Brisb. 1924.

TASMANIA.

MAY, W. L. Check-list of mollusca of Tasmania. Hobart.
ROYAL SOCIETY OF TASMANIA. Proc., 1923. Hobart. 1924.
TASMANIA. *Dept. of Mines.* Underground water paper, no. 3.
——— *Geological Survey.* Bull., no. 33-34. Hobart. 1923.
——— ——— Mineral resources, No. 7. Hobart. 1922.

VICTORIA.

ROYAL SOCIETY OF VICTORIA. Proc., v. 32, pt. 2; 36. Melb. 1920-23.
SCIENTIFIC AUSTRALIAN, v. 29, no. 5-12; 30, no. 1-5. Melb. 1923-24.
VICTORIA. *Dept. of Agriculture.* Journ., v. 21, pt. 10-12; 22, pt. 1-9.
——— *Geological Survey.* Bull., no. 42, 46-47, and maps. Melb.
VICTORIAN NATURALIST, v. 40; 41, no. 1-5. Melb. 1923-24.

WESTERN AUSTRALIA.

ROYAL SOCIETY OF W.A. Journ., v. 9, pt. 2. Perth. 1923.
WESTERN AUSTRALIA. *Dept. of Agriculture.* Journ., v. 1, pt. 1-3. 1924.
——— GEOLOGICAL SURVEY. Bull., no. 89. Perth. 1924.

ENGLAND.

BRITISH ANTARCTIC EXPEDITION, 1910-13. Meteorology, v. 1-3.
——— Physiography, Robertson Bay, Terra Nova Bay, Beardmore Glacier, Ross Archipelago. Lond. 1923.
BRITISH EMPIRE EXHIBITION, 1924. Handb. to exhib. of pure science.
BRITISH MUSEUM (NAT. HIST.). Economic ser., no. 13. Lond. 1922.
——— Selous collection catalogue. Lond. 1921.
CAMBRIDGE PHILOSOPHICAL SOCIETY. Proc., v. 21, pt. 6; 2, pt. 1. 1923-24.
——— Trans., v. 23, no. 2-3. Camb. 1924.
——— *Biological Science.* Proc., v. 1, no. 1-2. Camb. 1923.
CONCHOLOGICAL SOCIETY. Journ., v. 17, no. 3-5. Lond. 1923-24.
DOVE MARINE LABORATORY. Report, 1923. Cullercoats.
ENTOMOLOGICAL SOCIETY. Trans., 1923, pt. 1-4. Lond. 1923-24.
GEOLOGICAL SOCIETY. Geological literature, 1915-19, 1923.
——— Journ., v. 79, pt. 3-4; 80, pt. 1-2. London. 1923-24.
HILL MUSEUM. Bull., v. 1, no. 3. Witley. 1923-24.
IMPERIAL BUREAU OF ENTOMOLOGY. Review, v. 1-5; 11; 12, pt. 1-7.
IMPERIAL INSTITUTE. Bull., v. 21; 22, no. 1. Lond. 1923-24.
LINNAEAN SOCIETY. Journ., bot. no. 309-10; zool., no. 235-9.
——— Proc., 1922-23. List, 1923-24. Lond.
LIVERPOOL BIOLOGICAL SOCIETY. Trans., v. 37. 1923.
MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY. Mem., v. 67, pt. 2.
NATIONAL PHYSICAL LABORATORY. Collected researches, v. 17. 1922.
ROYAL BOTANIC GARDENS, KEW. Bull., 1923. Lond. 1924.
ROYAL GEOGRAPHICAL SOCIETY. Journ., v. 62-63; 3 vols. of Indexes.
ROYAL MICROSCOPICAL SOCIETY. Journ., 1923; 1924, pt. 1-2. Lond.
ROYAL SOCIETY. Proc., A724-36; B666-78. Yearbook, 1924. Lond.
UNITED EMPIRE, v. 14, no. 9-12; 15, no. 1-8. Lond. 1923-24.

SCOTLAND.

EDINBURGH GEOLOGICAL SOCIETY. Trans., v. 11, pt. 2. 1923.
ROYAL PHYSICAL SOCIETY. Proc., v. 20, pt. 6. Edin. 1923.
ROYAL SOCIETY OF EDINBURGH. Proc., v. 43, pt. 2-3; 44, pt. 1. 1923-24.
——— Trans., v. 53, pt. 2; 54, pt. 1. Edin. 1924.

IRELAND.

Royal Dublin Society. Scientific proc., v. 17, no. 11-41. 1922-23.
Royal Irish Academy. Proc., A, v. 33, pt. 6; 36, pt. 5-7; B, v. 33, pt. 4-6; 36, pt. 4-11; C, v. 33, pt. 12-19; 36, pt. 10-19. Dubl. 1917-24.

ARGENTINE.

Academia Nacional de Ciencias. Bull., t. 26; 27, pt. 3. Cordoba.

AUSTRIA.

Akademie der Wissenschaften. Sitz., Abt. I, Bd. 130, H. 10; 131, H. 1-10; 132, H. 3-8; IIa, Bd. 131-2; IIb, Bd. 131, H. 2-10; 132, H. 1-6; III, Bd. 130-31.
Geologische Staatsanstalt. Verh., 1923; 1924, no. 2-6. Wien.
Naturhistorischen Hofmuseums. Ann., Bd. 36-37. Wien. 1923-24.
Zool.-Bot. Gesellschaft. Verh., Bd. 64-69. Wien. 1914-19.

BELGIUM.

Académie Royale de Belgique. Ann. 1924. Brux.
——— *Classe des Sciences.* Bull., 1923. Brux.
——— ——— Mem. in 4°, t 5, f. 2-6; in 8°, t 7, f. 4-12. 1923-24.
Institut Royal Météorologique. Ann., 1914-20. Brux.
Instituts Solvay. Archives soc., t. 1, no. 2-3; 2, no. 1-3. Brux. 1923-24.
——— Revue de l'Institut de Sociologie, 1920-23.
Musée Royal d' Histoire Naturelle de Belgique. Mem. 33. Brux.
Observatoire Royal. Annales, t. 1, f. 2. Annuaire, 1924. Brux.
Société Royale de Botanique. Bull., t. 55; 56, f. 1. Brux. 1922-23.
Société Royale Zoologique. Ann. t. 53, 1922. Brux. 1923.

BRAZIL.

Instituto Oswaldo Cruz. Mem., t. 15, f. 1. Rio de Janeiro. 1922.
Observatorio Nacional do Rio de Janeiro. Ann., 1924.
Museu Paulista. Revista, t. 13. S. Paulo. 1923.

CANADA.

Canadian Arctic Expedition, 1913-18. Rep., v. 12, pt. A-C. Ottawa.
Canada. *Geological Survey.* Mem. 133-7. Museum bull. 37.
——— ——— Index to reports 1905-16; and 5 publications.
——— *Mines.* Publ. 555, 605, 611, 614. Ottawa. 1923.
Canadian Institute. Trans., v. 14, pt. 2. Ottawa. 1923.
Nova Scotian Institute of Science. Proc., v. 15, pt. 2-3. Halifax.
Royal Society of Canada. Proc., v. 17, 1923. Ottawa.

CHINA.

China. *Geological Survey.* Palaeontologia Sinica, A, v. 1, f. 1; B, v. 1, f. 1; 2, f. 1; D, v. 1, f. 1. Peking. 1922-23.

DENMARK.

Conseil Permanent International pour l' Exploration de la Mer. Bulletin of statistics, v. 11. Cpng. 1919-20.
——— Pub. de circ., no. 82. Rapports, v. 31-32. 1922-23.
Kobenhavn Universitets Zool. Museum. Bull. 28-31, 33-36.

FRANCE.

Muséum National d' Histoire Naturelle. Bull., 1923; 1924, no. 1-2.
Rennes University. Travaux scientifiques, t. 17. 1924.
Société des Sciences Naturelles de l' Quest de France. Bull. 2.
Société Entomologique de France. Ann., v. 92; 93, pt. 1-2. 1923-24.
——— Bull., 1923, no. 11-18, 21; 1924, no. 1-12, 19-20. Paris.
Société Geologique de France. Bull., t. 22; 23, no. 5-8. Paris.
——— Comte rendu, 1922, no. 3-17; 1923, no. 3-6, 8-11.
Société Linnéenne de Bordeaux. Actes, t. 74. 1922.
Société Linnéenne de Normandie. Bull., v. 5. Caen. 1923.
Société Zoologique de France. Bull., t. 45-46. Paris. 1920-21.

GERMANY.

Bayerische Akademie der Wissenschaften. *Math.-phys.* Abh., Bd. 27, no. 5; 30, no. 1. Sitz., 1914; 1923, H. 1-2. München.
Berliner Gesellschaft für Anthropologie. Zeits., 1923.
Botanischen Gartens u. Museums. Notizb., Bd. 1-8. App. 1-36, 38.
Deutsche Entologische Museum. Ent. Mitt., Bd. 12; 13, no. 1-3.
Fedde, F. Repertorium, Bd. 9; 18; 19, no. 1-25. Berl. 1910-24.
Gesellschaft der Wissenschaften. Nach., 1923; 1924, H. 1. Gott.
Gesellschaft für Erdkunde. Zeits., 1922, no. 5-6; 1923, 8-10; 1924, 3-4.
Naturforschende Gesellschaft. Berichte, Bd. 23, H. 2. Freiburg.
Naturhistorische Gesellschaft. Abh., Bd. 21, H. 4. Nürnberg.
Oberhessische Gesellschaft für Natur. u. Heilk. Abt., Bd. 9. Giessen.
Phys.-Med. Gesellschaft. Verh. Bd. 46, no. 1; 47, no. 3; 48, no. 1. Würzburg.
Preuss. Akad. der Wissenschaften. Sitz., 1923, pp. 75-160; 1924, pp. 1-82.
——— *Phil.-hist. Klasse.* Sitz., 1923, no. 17-34; 1924, no. 1-14. Berl.
——— *Phys.-math. Klasse.* Sitz., 1923, no. 15-34; 1924, no. 1-13. Berl.
Senckenbergische Naturf. Gesellschaft. Bericht 52-53; 54, H. 1-2.
——— "Senckenbergiana," Bd. 5; 6, H. 1-4. Frankfurt a M. 1923-24.

HAWAIIAN ISLANDS.

Bernice Pauahi Bishop Museum. Bull. 2-9. 1923.
——— Mem., v. 8, no. 5; 9, no. 1-2. Honolulu. 1923.
Hawaiian Entomological Society. Proc., v. 5, no. 2. 1922.

HUNGARY.

Museum Nationalis Hungaricum. Ann., v. 20. Budapest. 1923.

INDIA.

India. *Agricultural Research Institute.* Report, 1922-23. Pusa.
——— *Board of Scientific Advice.* Report, 1922-23. Calc.
——— *Dept. of Agriculture.* Mem.: bot., v. 12, no. 2-5; 13, no. 2; chem., v. 7, no. 2-3; entom., v. 8, no. 4. Calc. 1923-24.
——— ——— Review of agricultural operations, 1922-23. Calc.
——— *Geological Survey.* Bibliog. of Indian geology, pt. 3.
——— ——— Mem., v. 45, pt. 2; 47, pt. 2; 49, pt. 1. 1923.
——— ——— Palaeontologia Indica, v. 8, no. 1. Calc. 1923.
——— ——— Records, v. 54, pt. 4; 55, pt. 1, 3-4; 56, pt. 1-2. 1923-24.
——— *Zoological Survey.* Annual report, 1920-23. Calc.
——— ——— Account of the echinoidea, II. Calc. 1922.

INDIAN MUSEUM. Mem., v. 5, no. 2; 7, no. 4. Calc. 1922-23.
——— Records, v. 21, pt. 2-3; 24, pt. 4; App. A; 25, pt. 1-4.
MADRAS. *Fisheries.* Bull., no. 15. Reports 3-6. 1922-23.
ROYAL ASIATIC SOCIETY, BOMBAY BR. Journ., v. 26, no. 2. 1923.

ITALY.

LABORATORIA DI ZOOLOGIA GENERALE E AGRARIA. Bull. 16. Portici.
MALPIGHIA, Anno. 29, f. 7-12. Catania. 1922-23.
SOCIETÀ DI SCIENZI NATURALI ED ECONOMICHE. Giorn., v. 31-31.
SOCIETÀ ITALIANA DI SCIENZE NATURALI. Atti, v. 62. Milan. 1924.

JAPAN.

JAPAN. *Imperial Earthquake Investigation Committee.* Notes, no. 4.
KYOTO IMPERIAL UNIVERSITY. *College of Engineering.* Mem. 3, no. 3-4.
——— *College of Science.* Mem. 6, no. 6; 7, no. 1-4. Kyoto. 1923-24.
NATIONAL RESEARCH COUNCIL. Jap. journ.: astron., v. 1, no. 6-7; 2, no. 1; bot., v. 2, no. 1; geol., v. 2, no. 2-4; physics, v. 2. Tokyo.
TÔHOKU IMPERIAL UNIVERSITY. Sci. rep., s. 1, v. 12, no. 3; s. 3, v. 2, no. 1-2.
——— Technology rep., v. 4, no. 1. Sendai. 1924.
TÔHOKU MATHEMATICAL JOURNAL, v. 23, no. 1-2. 1923.

JAVA.

NATUURKUNDIGE VEREENIGING IN NED.-IND. Tijds., Deel 83-84.
NED.-OOST-IND.. *Mijnwezen.* Jaarbook 1920-21, and atlas.

MEXICO.

INSTITUTO GEOLÓGICO DE MEXICO. Bull., no. 42, 47. 1923.
MEXICO. *Departmento de Salubridad Publica.* Bull., t. 2, 7-12.
——— *Secretaria de Comunicaciones.* An., t. 5-6. 1922-23.
——— *Secretaria de Agricultura.* Bull., t. 7, no. 9-12. 1923.
SOCIEDAD CIENTÍFICA "ANTONIO ALZATE." Mem., t. 41-42. Mexico. 1923.

NEW ZEALAND.

AUCKLAND INSTITUTE AND MUSEUM. Annual report, 1923-24.
CANTERBURY MUSEUM. Records, v. 2, no. 3. Christchurch. 1923.
NEW ZEALAND. *Board of Science and Art.* Journ. of sci., v. 6; 7, no. 1-2.
——— *Dept. of Mines.* Palaeontological bull., no. 10. Well. 1924.
——— *Dominion Laboratory.* Report, no. 56. Well. 1923.
——— *Dominion Museum.* Bull., no. 7, 10. Report, 1922. Well.
——— *Geological Survey.* Bull. 24-25. Report 18. 1923-24.
NEW ZEALAND INSTITUTE. Trans., v. 54. Well. 1923.

NORWAY.

BERGENS MUSEUM. Aarb., 1921-22. Aarsb., 1922-23.
K. NORSKE VIDENSKABERS SELSKAB. Skr., 1921-22. Trondhjem.
NORWEGIAN "AURORA POLARIS" EXPEDITION, 1902-03. Rep., v. 1. 1908.

PHILIPPINE ISLANDS.

BUREAU OF SCIENCE. Journ., v. 23-24; 25, no. 1. Manila.

POLAND.

SOCIÉTÉ BOTANIQUE DE POLOGNE. Publication, no. 1-2. Warsaw. 1923.

SPAIN.

Instituto General y Técnico de Valencia. Anales, v. 10. 1923.
Real Academia de Ciencias y Artes. Bull., v. 4, no. 7; 5, no. 1.
——— Mem., v. 17, no. 23; 18, no. 1-9. Barcelona. 1923-24.

STRAITS SETTLEMENTS.

Royal Asiatic Society, Malayan Br. Journ., v. 1; 2, pt. 1. Singapore.

SWEDEN.

Entomologiska Föreningen. Tidsk., Arg. 44. Stockholm. 1923.
Geologiska Föreningen. Forh., Bd. 45, H. 5-7; 46, H. 1-4.
K. Vitterhets Hist. och Antik. Akad. Fornv., 1922. Stockholm.
Regia Societas Scientiarum Upsaliensis. Nova acta, v. 5, f. 2.

SWITZERLAND.

Naturforschende Gesellschaft in Basel. Verh., Bd. 8-35. 1886-1923.
Naturforschende Gesellschaft in Zürich. Viert., 1923.
Société de Physique et d' Histoire Nat. Comte rendu, v. 40; 41, no. 1.
——— Mem., v. 39, f. 1-2, 8. Geneva. 1916-23.
Société Neuchâteloise des Sciences Nat. Bull., t. 47; Index t. 26-45.
Société Vaudoise des Sciences Nat. Bull. 210-213. Mem. 3-7. 1923.

UNION OF SOUTH AFRICA.

Geological Society of S.A. Trans., 1923. Johannesb. 1924.
Royal Society of S.A. Trans., v. 11, pt. 2-4. Cape Town. 1923-24.
S.A. Association for the Advancement of Science. Journ., v. 20.
S.A. Museum. Ann., v. 12, pt. 8; 13, pt. 8; 14, pt. 6; 19, pt. 1-2; 20, pt. 1.
——— Guide leaflet, no. 1. Report, 1923. Cape Town.

UNITED STATES.

American Academy of Arts and Sciences. Mem., v. 14, no. 4.
——— Proc., v. 56, no. 5-8; 58; 59, no. 1-9. Bost. 1923-24.
American Chemical Society. Journ., v. 45; 46, no. 1-8. Easton, Pa.
American Geographical Society. Review, v. 13, no. 4; 14, no. 1-3. N.Y. 1923.
American Institute of Mining Engineers. Trans., v. 69. N.Y. 1923.
American Microscopical Society. Trans., v. 42; 43, no. 1-2. 1923.
American Museum of Natural History. Ancient quipu, The. 1923.
——— Anthropological papers, v. 19, pt. 5; 22, pt. 5; 23, pt. 6. 1923-24.
——— Bibliography of fishes, v. 3. Bull., v. 46. N.Y.
——— Essentials of anthropometry. N.Y. 1923.
——— Guide leaflets, no. 52, 57-58. Handbook, no. 9. N.Y. 1923.
——— "Natural History," v. 19, no. 6; 22, no. 5; 23, no. 5-6; 24, no. 1-3.
——— Novitates, no. 83-111, 116-126. Report, 1922. N.Y.
Arnold Arboretum. Journ., v. 4, no. 3-4; 5, no. 1-2. Camb., Mass.
Boston Society of Natural History. Mem., v. 3, no. 1-3; 6, no. 2; 7.
——— Occas. papers, v. 1-4; 5, pp. 5-67; 6. Proc., v. 36; 37, no. 1.
Brooklyn Institute. Museum quarterly, v. 10; 11, no. 1. 1923-24.
California Academy of Sciences. Proc., v. 11, 22-23; 12, 6-26; 13, 1-6.
California. *Mines.* Bull. 92-93. Oilfields summary, v. 8; 9, no. 1-10.
——— ——— Report, v. 18, no. 7-12; 19, no. 1-4; 20, no. 1-2. Sacr. 1922-23.

CALIFORNIA UNIVERSITY. *Agric. Exp. Station.* Bull. 360, 367, 374, 376.
——— Publications: arch., v. 13, no. 6-9; 15, no. 5; 17, no. 3; 18, pp. 1-285; 20; bot., v. 5, no. 17; 7, no. 11-14; 9; 10, no. 1-7; 11, no. 1; geol., v. 12, no. 5; 13, no. 1-10; 14, no. 1-13; zool., v. 20, no. 8-21; 21, no. 6-12; 22, no. 2, 4, 7-13; 24, no. 1-2.
CARNEGIE INSTITUTE OF WASHINGTON. Yearbook, no. 1, 6-22. 1902-22.
CONN. ACADEMY OF ARTS AND SCIENCES. Trans., pp. 181-332.
CORNELL UNIVERSITY. *Agric. Exp. Station.* Bull. 411-413. 1922.
——— ——— Mem., no. 53, 55-58, 60-63, 65. Ithaca, N.Y.
DENISON SCIENTIFIC ASSOCIATION. Bull. 20, art. 4-8. Granv., O. 1923.
FIELD MUSEUM. Botany, v. 5. Report, v. 6, no. 2. Chic. 1923.
FRANKLIN INSTITUTE. Journ., v. 196-7; 198, no. 1-2. Yearbook, 1923. Phil.
HARVARD COLLEGE MUSEUM. Bull., v. 65, no. 9-12. Report, 1922-23.
ILLINOIS. *State Lab. Nat. Hist.* Bull., v. 13, no. 13; 14, no. 3-10; 15, no. 1.
ILLINOIS UNIVERSITY. Biological monograph, v. 8, no. 1-2. Urbana.
INDIANA ACADEMY OF SCIENCE. Proc., 1922. Indianapolis.
JOHNS HOPKINS UNIVERSITY. Studies, v. 41. Balt. 1923.
KANSAS UNIVERSITY. Bull.: humanistic, v. 3, no. 2; sci., v. 23, no. 18; v. 24, no. 8.
MARINE BIOLOGICAL LAB. Bull., v. 3, no. 3, 5-6; 4; 5, no. 1-5; 6-15; 17, no. 1-3, 6; 18-22; 43-46; 47, no. 1-2. Lanc., Pa. 1902-24.
MARYLAND. *Geol. Surv. Reports.* 11th, general; 8th, Silurian. Balt.
MINNESOTA. *Agric. Exp. Station.* Bull. 200-205. Minneapolis.
——— *Geol. and Nat. Hist. Survey.* Bull. 18. Minneapolis. 1923.
MISSISSIPPI. *Geological Survey.* Bull. 19. Jackson. 1923.
MISSOURI BOTANIC GARDEN. Ann., v. 9; 10, no. 1-3. St. Louis. 1922-23.
NATIONAL ACADEMY OF SCIENCES. Proc., v. 9, no. 9-12; 10, no. 1-7.
——— *Research Council.* Circ. 49. List, 1923-24. Wash.
NELA RESEARCH LABORATORY. Bull., v. 1, no. 3. Cleveland, O. 1922.
NEW YORK PUBLIC LIBRARY. Bull., v. 27; 28, no. 1-7. 1923-24.
NEW YORK STATE MUSEUM. Bull. 213-14, 217-20, 223-38, 241-51.
NEW YORK ZOOL. SOC. Zool., v. 2, no. 18; 3, no. 14-23; 4, no. 1; 5, no. 1-16.
N. CAROLINA. *Geol. Survey.* Bull. 30, 32-33; Circ. 5, 7-9; "Natural Resources," v. 1, no. 1-15, 17-26; 2, no. 1-8. Raleigh. 1923-24.
OHIO UNIVERSITY. Journ. sci., v. 23, no. 4-6; 24, no. 1-4. 1923-24.
——— *Biological Survey.* Bull., v. 3, no. 1-2. Columbus, O.
SMITHSONIAN INSTITUTION. Annual report, 1921. Wash. 1922.
——— *Ethnology.* Bull. 40, pt. 2; 79-81. Report 37. Wash.
STANFORD UNIVERSITY. Biol. sci., v. 2, no. 3, pt. 2; v. 3, no. 1-4.
——— *Terrestrial Electric Observatory.* Vol. 1. Palo Alto, Cal.
TENNESSEE. *Geological Survey.* Bull. 30. Nashville. 1923.
UNITED STATES. *Coast and Geodetic Survey.* Rep., 1923, and 4 serials.
——— *Dept. of Agriculture.* Experiment station record, v. 49-50.
——— ——— Journ. agric. research, v. 24-25; 26, 2-12; 27, 1-5, 8-10.
——— ——— North American fauna, no. 46. Wash. 1923.
——— ——— Yearbook, 1922; 6 bulletins; 3 circulars.
——— *Geological Survey.* Mineral resources, 1920-21. Wash.
——— ——— Rep. 44; various bulletins, prof. and water supply papers.
——— *Library of Congress.* Report, 1923. Wash.
——— *National Museum.* Contrib. from Nat. Herb., v. 23, pt. 3.
——— ——— Proc., v. 61-62; rep., 1923; various bulletins. Wash.
WAGNER FREE INSTITUTE OF SCIENCE. Ann. announcement, 1924. Phil.
WASHINGTON UNIVERSITY, ST. LOUIS. Sci. studies, v. 10, no. 2; 11, no. 1-2.

LIST OF FELLOWS, MEMBERS, ETC.

AS EXISTING ON SEPTEMBER 30, 1924.

Those marked with an asterisk have contributed papers published in the Society's Transactions.

Any change in address should be notified to the Secretary.

Note.—The publications of the Society will not be sent to those whose subscriptions are in arrear.

Date of Election.

Honorary Fellows.

1910. *Bragg, Sir W. H., K.B.E., M.A., D.Sc., F.R.S., Professor of Physics, University College, London (Fellow 1886).
1893. *Cossman, M., 2 Boulvd. Sadi-Carnot, Enghien, France.
1897. *David, Sir T. W. Edgeworth, K.B.E., C.M.G., D.S.O., B.A., D.Sc., F.R.S., F.G.S., Professor of Geology, University of Sydney.
1905. *Hedley, Chas., c/o University, Brisbane, Queensland.
1892. *Maiden, J. H., I.S.O., F.R.S., F.L.S., Turramurra Ave., Turramurra, N.S.W.
1898. *Meyrick, E. T., B.A., F.R.S., F.Z.S., Thornhanger, Marlborough, Wilts, England.
1894. *Wilson, J. T., M.D., Ch.M., Professor of Anatomy, Cambridge University, England

Corresponding Members.

1913. *Carter, H. J., B.A., Kintore Street, Wahroonga, N.S.W.
1909. *Johncock, C. F., Clare.
1905. Thomson, G. M., F.L.S., 209 Cargill Street, Dunedin, New Zealand.
1908. *Woolnough, Walter G., D.Sc., F.G.S. (Fellow 1902).

Fellows.

1895. *Ashby, Edwin, F.L.S., M.B.O.U., Blackwood.
1917. Bailey, J. F., Director Botanic Garden, Adelaide.
1902. *Baker, W. H., F.L.S., King's Park.
1902. *Black, J. M., 82 Brougham Place, North Adelaide.
1912. *Broughton, A. C., Moorlands, Tailem Bend.
1911. Brown, Edgar J., M.B., D.Ph., 172 North Terrace.
1883. *Brown, H. Y. L., 286 Ward Street, North Adelaide.
1924. Browne, J. W., B.Ch., 169 North Terrace.
1916. *Bull, Lionel B., D.V.Sc., Laboratory, Adelaide Hospital.
1923. Burdon, Roy S., B.Sc., University of Adelaide.
1921. Burton, R. J., Fuller Street, Walkerville.
1922. *Campbell, T., D.D.S., Dental Dept., Adelaide Hospital, Frome Road.
1924. Cavenagh-Mainwaring, W. R., M.B., B.S., 207 North Terrace.
1907. *Chapman, R. W., M.A., B.C.E., F.R.A.S., Professor of Engineering and Mechanics, University of Adelaide.
1904. Christie, W., c/o Griffiths Bros., King William Street, Adelaide.
1895. *Cleland, John B., M.D., Professor of Pathology, University of Adelaide.
1923. Conrick, John, Nappermerrie, Farina.
1907. *Cooke, W. T., D.Sc., Lecturer, University of Adelaide.
1924. Crespigny, C. T. C. de, 172 North Terrace.
1916. Darling, H. G., Franklin Street, Adelaide.
1887. *Dixon, Samuel, Bath Street, New Glenelg.
1915. *Dodd, Alan P., Prickly Pear Laboratory, Sherwood, Brisbane.
1921. Dutton, G. H., B.Sc., F.G.S., 21 Da Costa Avenue, South Prospect.
1911. Dutton, H. H., B.A., Anlaby.
1902. *Edquist, A. G., Second Avenue, Sefton Park.
1918. *Elston, A. H., F.E.S., "Hatherley," Commercial Road, Unley Park.
1917. *Fenner, Chas. A. E., D.Sc., F.G.S., Education Department, Adelaide.
1914. Ferguson, E. W., M.B., Ch.M., Gordon Road, Roseville, Sydney.
1923. Fry, H. K., M.B., B.S., B.Sc., Glen Osmond Road, Parkside.
1919. Glastonbury, O. A., Adelaide Cement Co., Brookman Buildings, Grenfell Street.
1923. Glover, C. R. J., Stanley Street, North Adelaide.
1904. Gordon, David, 72 Third Avenue, St. Peters.
1880. *Goyder, George, A.M., F.C.S., Gawler Place, Adelaide.
1910. *Grant, Kerr, M.Sc., Professor of Physics, University of Adelaide.
1922. Grant, R. L. T., M.B., B.S., M.R.C.P., University of Adelaide.
1904. Griffith, H., Hove, Brighton.
1924. Guinnane, F. R., King Street, Brighton.
1916. Hackett, W. C., 35 Dequetteville Terrace, Kent Town.
1922. *Hale, H. M., Irish Harp Road, Prospect.
1922. *Ham, William, F.R.E.S., University of Adelaide.
1916. Hancock, H. Lipson, A.M.I.C.E., M.I.M.M., M.Am.I.M.E., Angaston.

Date of
Election.

1924. HAWKER, C. A. S., North Bungaree, via Yacka.
1896. HAWKER, E. W., F.C.S., East Bungaree, Clare.
1923. HILL, FLORENCE M., B.S., M.D., University of Adelaide.
1924. HOSSFELD, PAUL S., Carey Street, Magill.
1883. *HOWCHIN, Professor WALTER, F.G.S., "Stonycroft," Goodwood East.
1918. *ISING, ERNEST H., Locomotive Department, S.A. Railways, Mile End.
1912. *JACK, R. L., B.E., F.G.S., Assistant Government Geologist, Adelaide.
1893. JAMES, THOMAS, M.R.C.S., 9 Watson Avenue, Rose Park.
1918. JENNISON, Rev. J. C., 31 Kyre Avenue, Kingswood.
1910. *JOHNSON, E. A., M.D., M.R.C.S., 295 Pirie Street.
1910. *JOHNSTON, Professor T. HARVEY, M.A., D.Sc., University of Adelaide.
1920. *JONES, F. WOOD, M.B., B.S., M.R.C.S., L.R.C.P., D.Sc., Professor of Anatomy, University of Adelaide.
1923. JUDELL, LESTER M. W., B.Sc., Jamestown.
1918. KIMBER, W. J., 28 Second Avenue, Joslin.
1915. *LAURIE, D. F., Agricultural Department, Victoria Square.
1897. *LEA, A. M., F.E.S., South Australian Museum, Adelaide.
1884. LENDON, A. A., M.D., M.R.C.S., North Terrace.
1922. LENDON, GUY A., M.B., B.Sc., M.R.C.P., North Terrace.
1888. *LOWER, OSWALD B., F.Z.S., F.E.S., Broken Hill, New South Wales.
1922. MADIGAN, C. T., B.A., B.Sc., University of Adelaide.
1923. MAGAREY, W. A., LL.B., Pirie Street.
1923. MARSHALL, J. C., Payneham.
1914. MATHEWS, G. M., F.R.S.E., F.L.S., F.Z.S., Foulis Court, Fair Oak, Hants, England.
1905. *MAWSON, SIR DOUGLAS, D.Sc., B.E., F.R.S., Professor of Geology, University, Adelaide.
1919. MAYO, HELEN M., M.B., B.S., 47 Melbourne Street, North Adelaide.
1920. MAYO, HERBERT, LL.B., Brookman Buildings, Grenfell Street.
1923. MCBRIDE, R. M., J.P., 14 Giles Street, Toorak.
1920. MCGILP, JOHN NEIL, Napier Terrace, King's Park.
1907. MELROSE, ROBERT T., Mount Pleasant.
1924. MESSENT, P. S., M.S., 192 North Terrace.
1897. *MORGAN, A. M., M.B., Ch.B., 46 North Terrace.
1924. MORISON, A. J., Deputy Town Clerk, Town Hall, Adelaide.
1921. MOULDEN, OWEN M., M.B., B.S., Broken Hill, N.S.W.
1913. *OSBORN, T. G. B., D.Sc., Professor of Botany, University of Adelaide.
1924. PEARCE, C., 33 Capper Street, Kent Town.
1924. PERKINS, A. J., Director of Agriculture, Victoria Square.
1907. *PULLEINE, R. H., M.B., North Terrace.
1916. RAY, WILLIAM, M.B., B.Sc., A.M.P. Chambers, King William Street.
1885. *RENNIE, EDWARD H., M.A., D.Sc., F.C.S., Professor of Chemistry, University, Adelaide.
1924. RICE, P. W., M.B., B.S., 137 Henley Beach Road, Mile End.
1911. ROACH, B. S., Education Department, Flinders Street.
1919. *ROBERTSON, Professor T. B., University of Adelaide.
1924. ROEGER, Miss M. T. P., Gaza.
1905. *ROGERS, R. S., M.A., M.D., 52 Hutt Street.
1922. *SAMUEL, GEOFFREY, B.Sc., University of Adelaide.
1924. SANDFORD, J. WALLACE, 75 Grenfell Street.
1924. SEGNIT, R. W., B.A., B.Sc., Architect-in-Chief's Office, King William Street.
1891. SELWAY, W. H., Treasury, Adelaide.
1920. SIMPSON, A. A., C.M.G., Lockwood Road, Burnside.
1924. SIMPSON, FRED. N., Dequetteville Terrace, Kent Town.
1906. SNOW, FRANCIS H., National Mutual Buildings, King William Street.
1923. SPROD, M. W., M.B., B.S., Mannum.
1910. *STANLEY, E. R., Government Geologist, Port Moresby, Papua.
1923. STRONG, Professor ARCHIBALD, M.A., D.Litt., University of Adelaide.
1922. SUTTON, J., Fullarton Road, Netherby.
1923. THOMAS, J. F., 64 Elizabeth Street, Sydney.
1923. *THOMAS, R. G., 5 Trinity Street, St. Peters.
1921. *TIEGS, OSCAR W., M.S., D.Sc., University of Adelaide.
1923. *TINDALE, N. B., South Australian Museum, Adelaide.
1894. *TURNER, A. JEFFERIS, M.D., F.E.S., Wickham Terrace, Brisbane, Queensland.
1878. *VERCO, SIR JOSEPH C., M.D., F.R.C.S., North Terrace.
1914. *WAITE, EDGAR R., F.L.S., C.M.Z.S., Director, South Australian Museum.
1924. WALKER, W. D., B.Sc., 65 Second Avenue, St. Peters.
1912. *WARD, LEONARD KEITH, B.A., B.E., Government Geologist, Adelaide.
1904. WHITBREAD, HOWARD, c/o A. M. Bickford & Sons, Currie Street.
1912. *WHITE, Capt. S. A., C.M.B.O.U., "Wetunga," Fulham.
1920. *WILTON, Professor J. R., D.Sc., University of Adelaide.
1923. *WOOD, J. G., B.Sc., University of Adelaide.

APPENDIX.

FIELD NATURALISTS' SECTION

OF THE

Royal Society of South Australia (Incorporated).

FORTY-FIRST ANNUAL REPORT OF THE COMMITTEE

FOR THE YEAR ENDED AUGUST 31, 1924.

GENERAL.—The work of the year has been well maintained, ten Lectures were given and Excursions were held fortnightly throughout the year. The subjects studied during the various excursions have been:—Astronomy, Sea Life, Physiography, Botany, Conchology, Ornithology, Fossils, and Forestry.

NATURAL HISTORY SURVEY OF THE NATIONAL PARKS AND RESERVES.—An attempt has been made, this year, to make a survey of the local parks and reserves, and so far three trips have been made to the National Park, Belair, and one each to Morialta and Waterfall Gully. Lists of the indigenous and naturalised flora are being prepared, and these will be brought up to date after subsequent visits. Mr. J. Sutton has offered his list of birds, and Dr. C. Fenner has agreed to write on the physiography and geology of the areas under survey. It is intended to print an account in "The S.A. Naturalist" of the work done with lists attached.

PLANT SURVEY AND HERBARIUM.—This subcommittee has had a busy time; several meetings were held and the Herbarium keepers and others have accomplished much good work in sorting out specimens. Cardboard boxes have been purchased, and Mr. J. F. Bailey has kindly presented a quantity of specimen folders. Specimens have been received from many parts of South Australia. Most of these are awaiting classification. The Royal Society granted £15 for this work, and about half the amount has been spent on boxes, cards, etc.

MEMBERSHIP.—On October 1, 1923, there were 185 members on the roll, and on September 1 this year there are 217 members. New members elected during the period were 43; the losses by resignation and death were several.

FLOWER SHOW, 1923.—The net proceeds were £25 15s. 8d. We are greatly indebted to the Lord Mayor for granting the use of the Town Hall on payment of working expenses. Only for this the Show would have resulted in a financial loss.

OUR JOURNAL.—"The South Australian Naturalist" has been issued regularly under the capable editorship of Mr. Wm. Ham, and volume V. was completed with the publication of the August number.

LIBRARY.—Members have made good use of the books, which have so increased as to make the cupboard in which they are stored quite inadequate. The Librarian makes a plea for a larger and more suitable cupboard.

(Signed) J. B. CLELAND, *Chairman.*
E. H. ISING, *Hon. Sec.*

FIELD NATURALISTS' SECTION OF THE ROYAL SOCIETY.

Statement of Receipts and Expenditure for Year ended August 30, 1924.

GENERAL ACCOUNT.

Receipts.	£	s.	d.	Expenditure.	£	s.	d.
To Balance Brought Forward	6	14	2	By Postages	14	11	3
" Wild Flower Show	27	19	0	" Printing	45	2	3
" Subscriptions	52	12	3	" Stationery	6	4	3
" Grant	50	0	0	" Wild Flower Show Prizes	2	3	4
" Sale of Badges, etc.	1	7	8	" Library Books	0	10	0
" Bank Interest	0	16	6	" Advertising	1	3	0
" Additional Subscriptions in hand	1	2	6	" Hire of Hall	6	3	1
				" Telegrams, etc.	0	8	6
				" Subscriptions paid to Royal Society	52	5	3
				" Balance in Bank due to Royal Society	1	2	6
				" Cash in Hand	0	7	0
				" Balance in Bank	10	11	8
	£140	12	1		£140	12	1
Subscriptions due to Royal Society	1	9	6				
Balance	10	11	8				

EXCURSION ACCOUNT.

Receipts.	£	s.	d.	Expenditure.	£	s.	d.
To Balance Brought Forward	3	18	9	By Hire of Motors	66	10	0
" Fares	74	16	9	" Refreshments, etc.	1	0	3
				" Hire of Launches	7	0	0
				" Tips to Sailors	1	0	0
				" Balance	3	5	3
	£78	15	6		£78	15	6
To Balance	£3	5	3				

Audited and found correct,

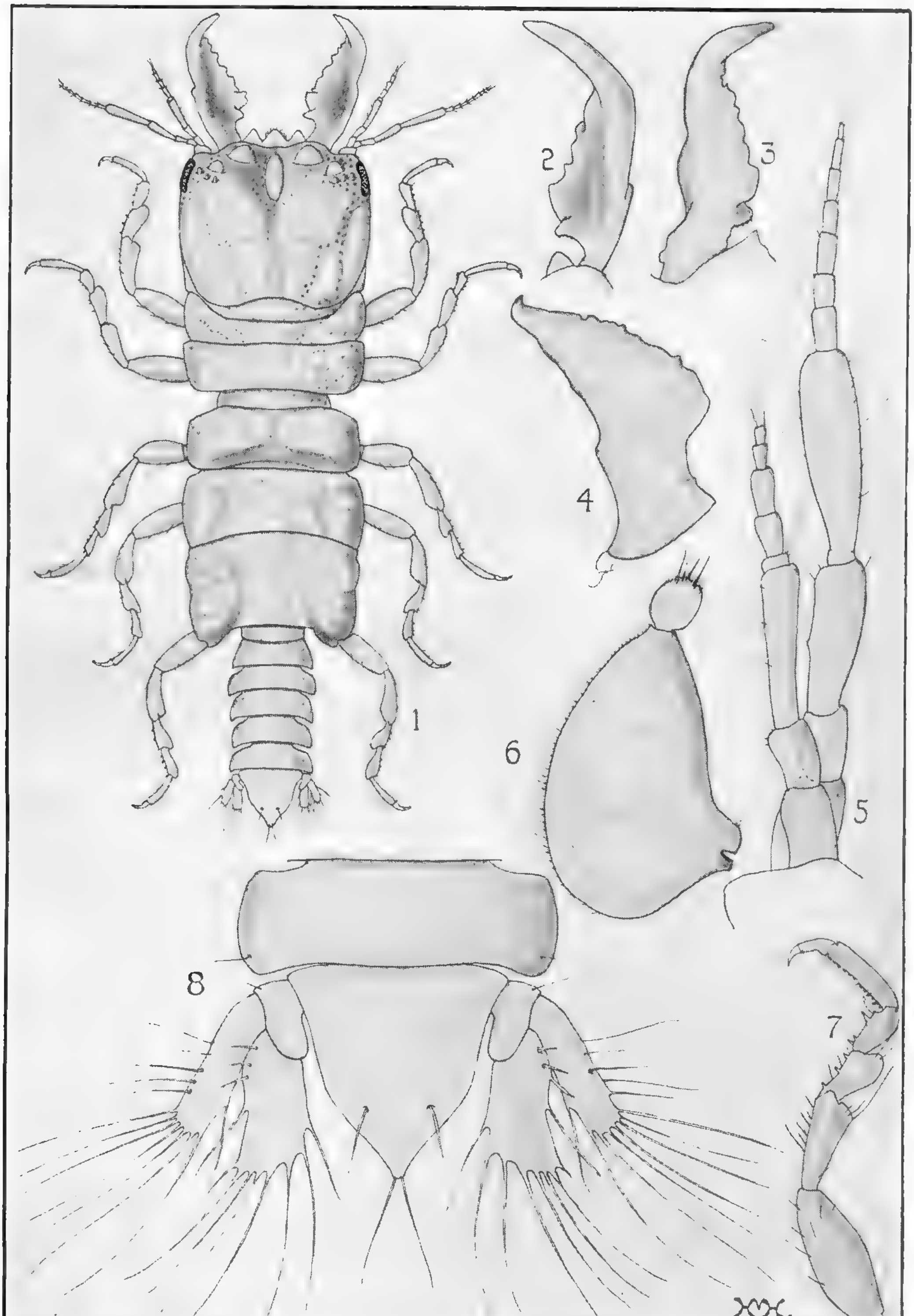
(Signed) WALTER D. REED, F.C.P.A., } Hon.
A. J. MORISON, } Auditors.

Adelaide, September 15, 1924.

BEAVIS B. BECK, Hon. Treasurer.
E. H. ISING, Hon. Sec.

GENERAL INDEX

[Generic and specific names in italics indicate that the forms described are new to science.]



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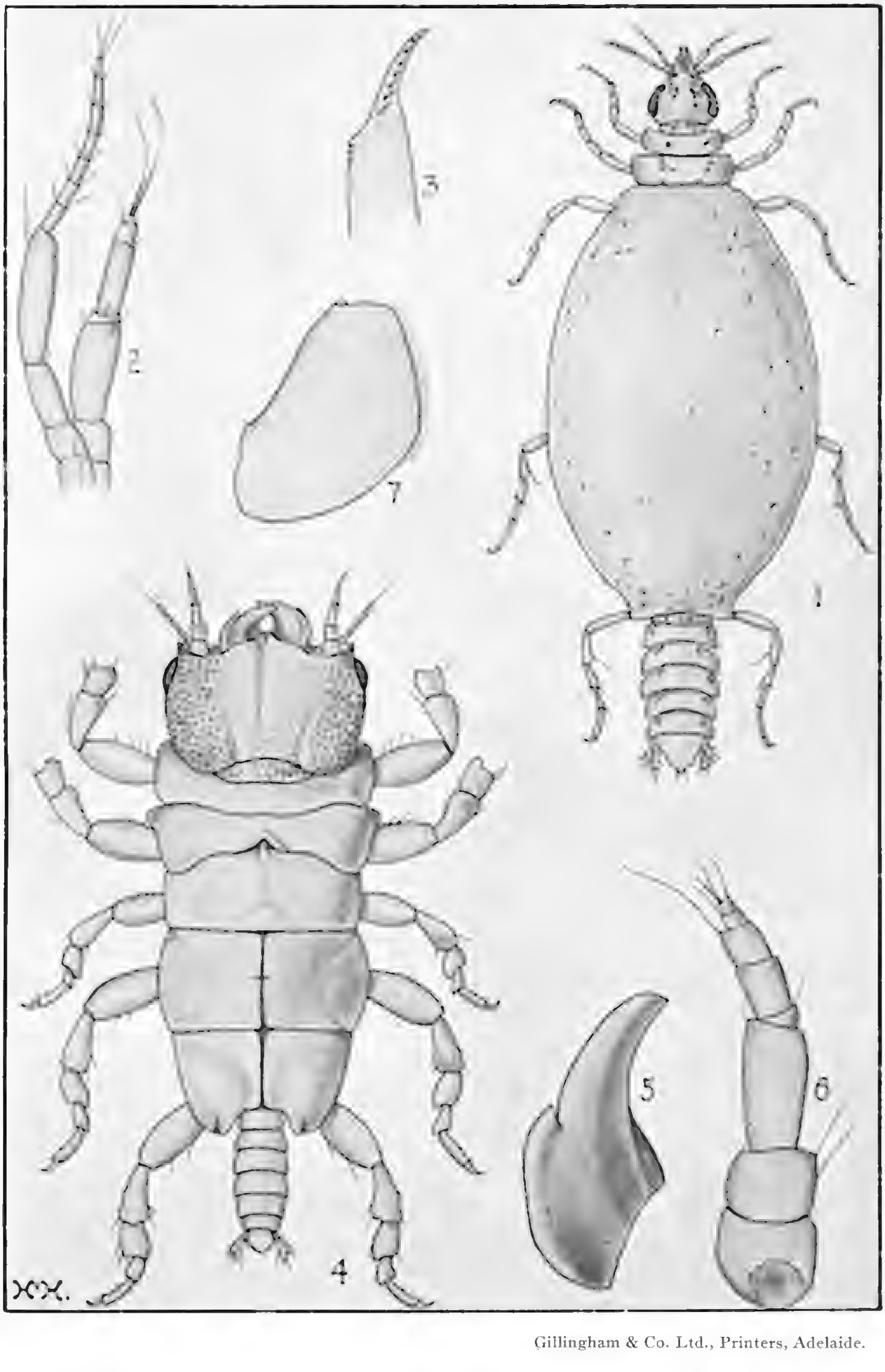

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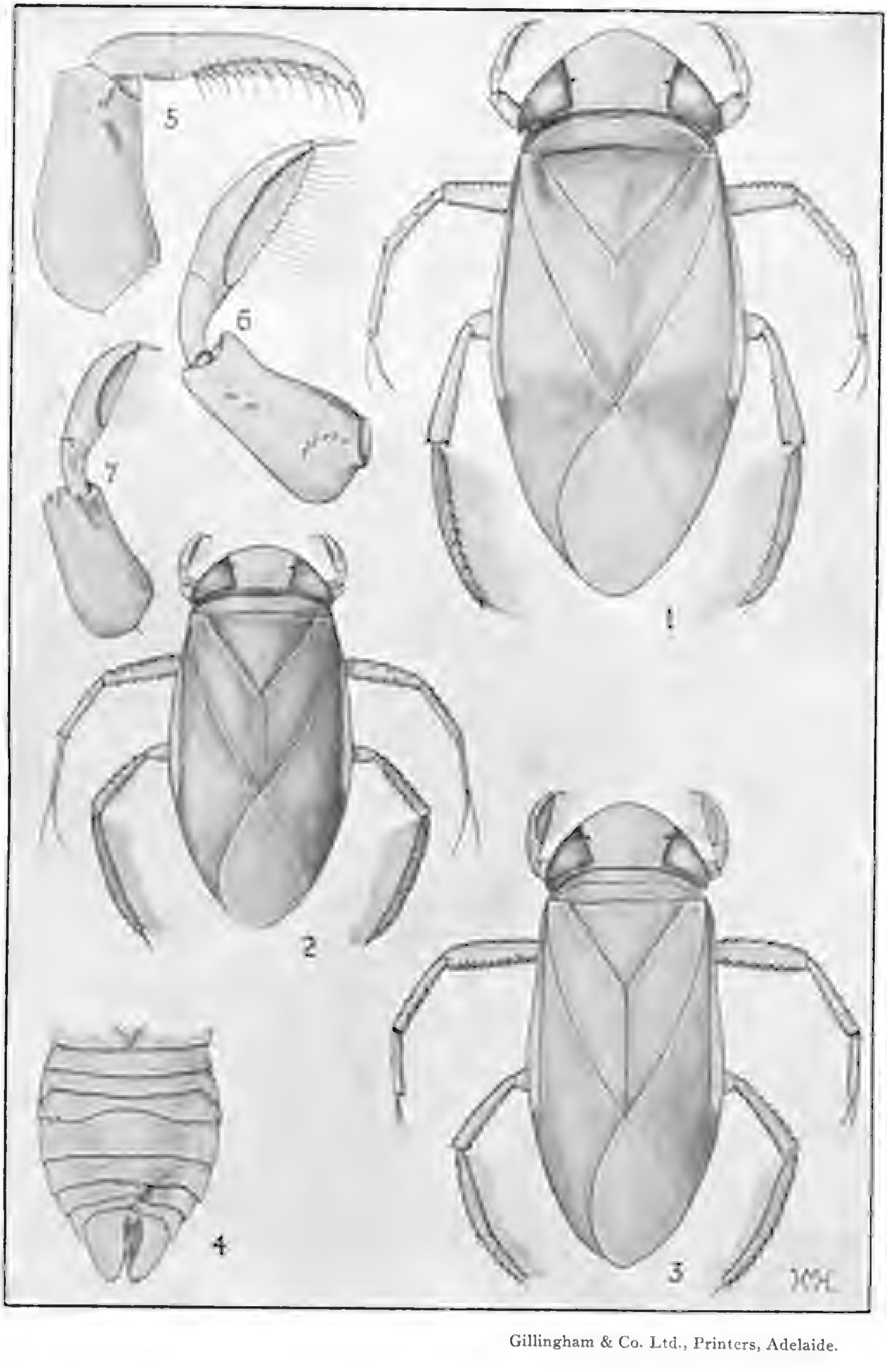

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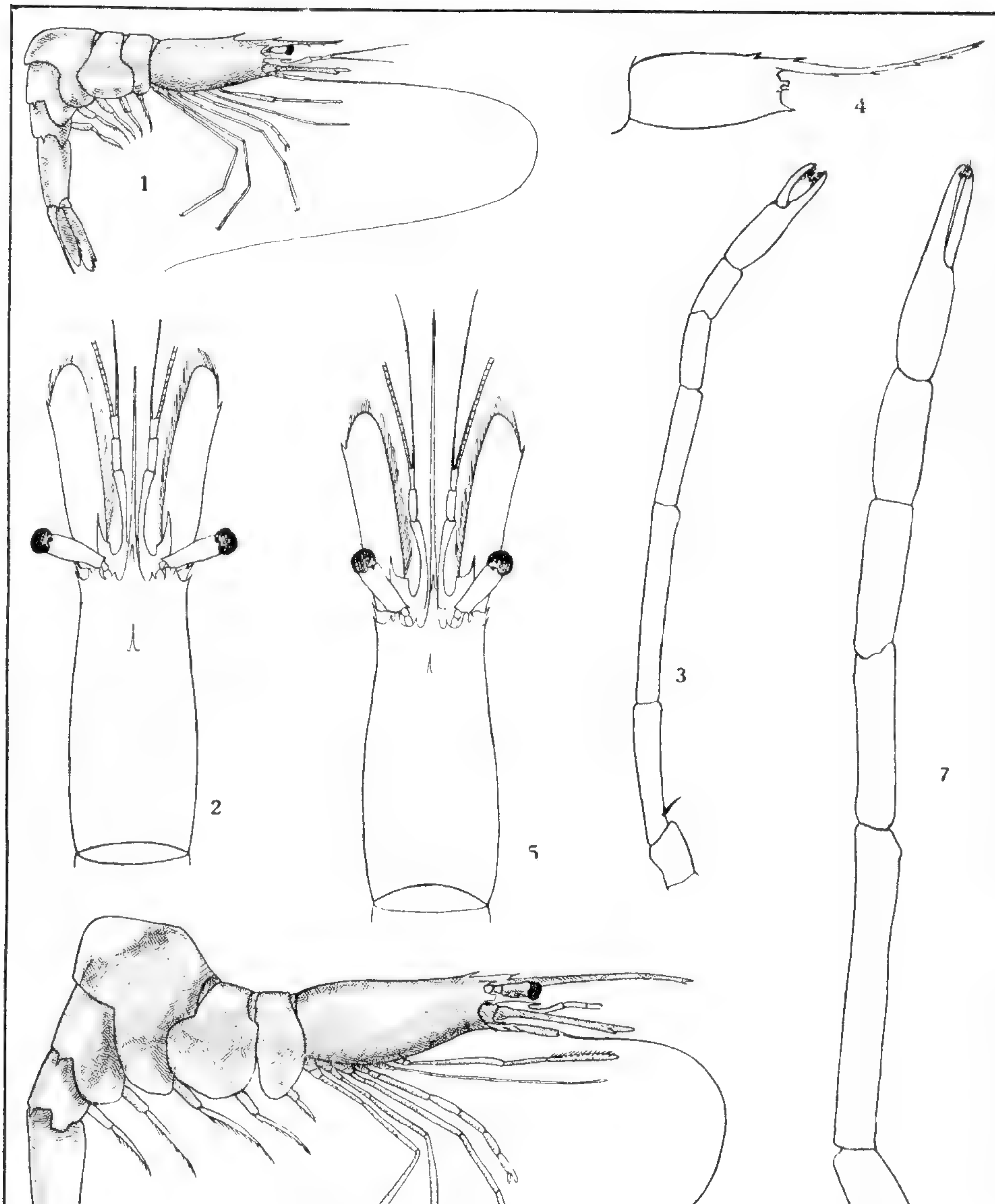

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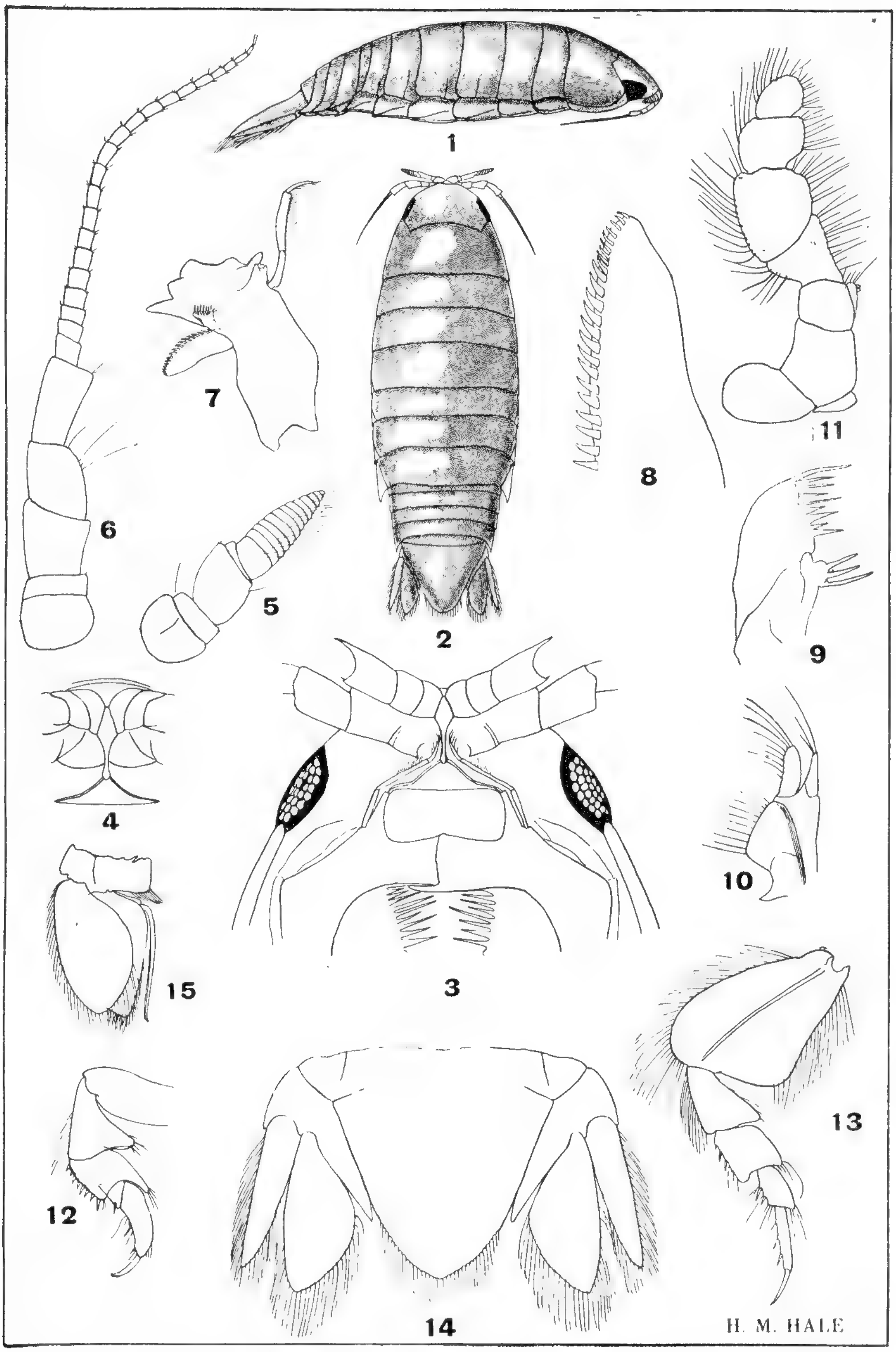

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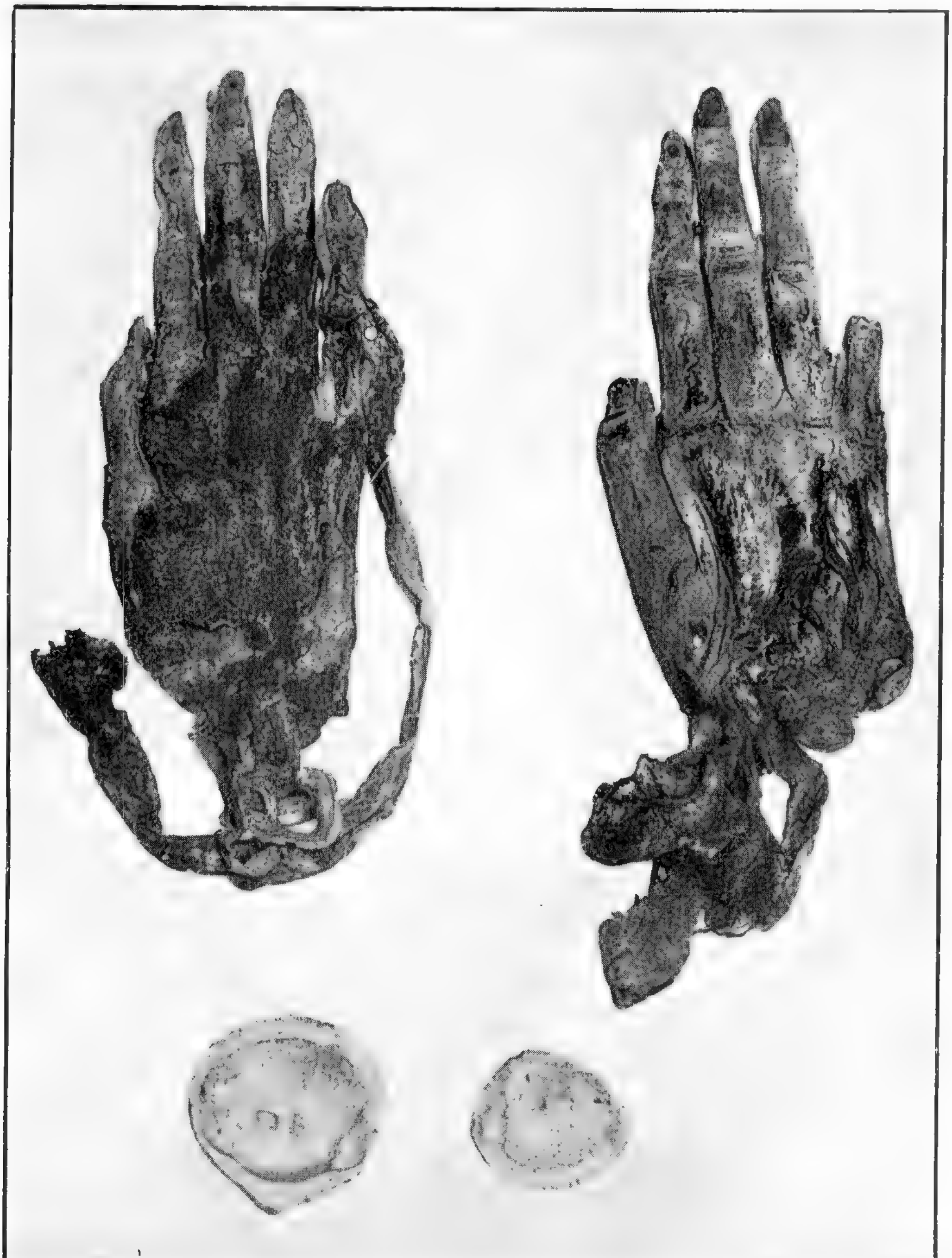

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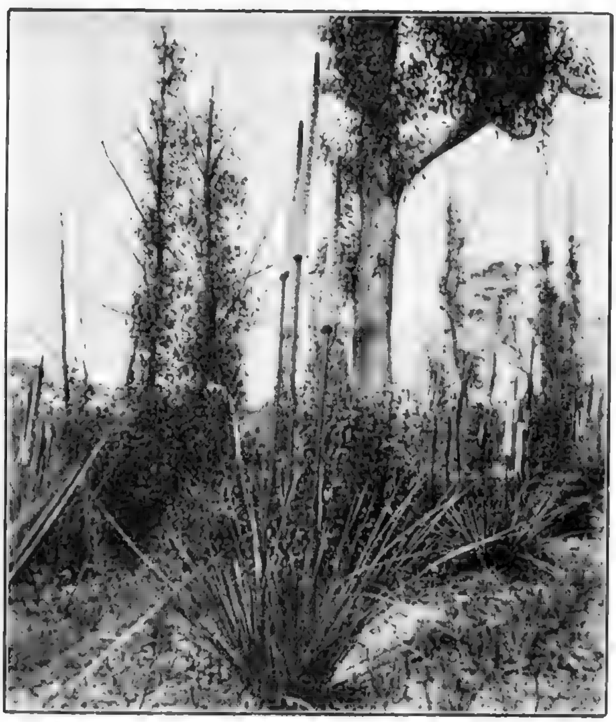

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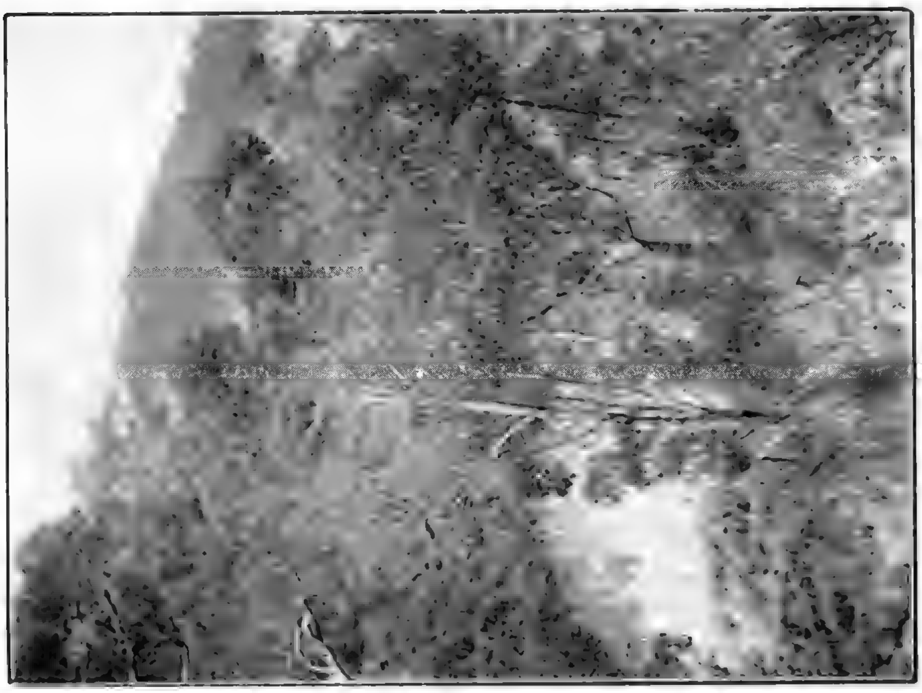

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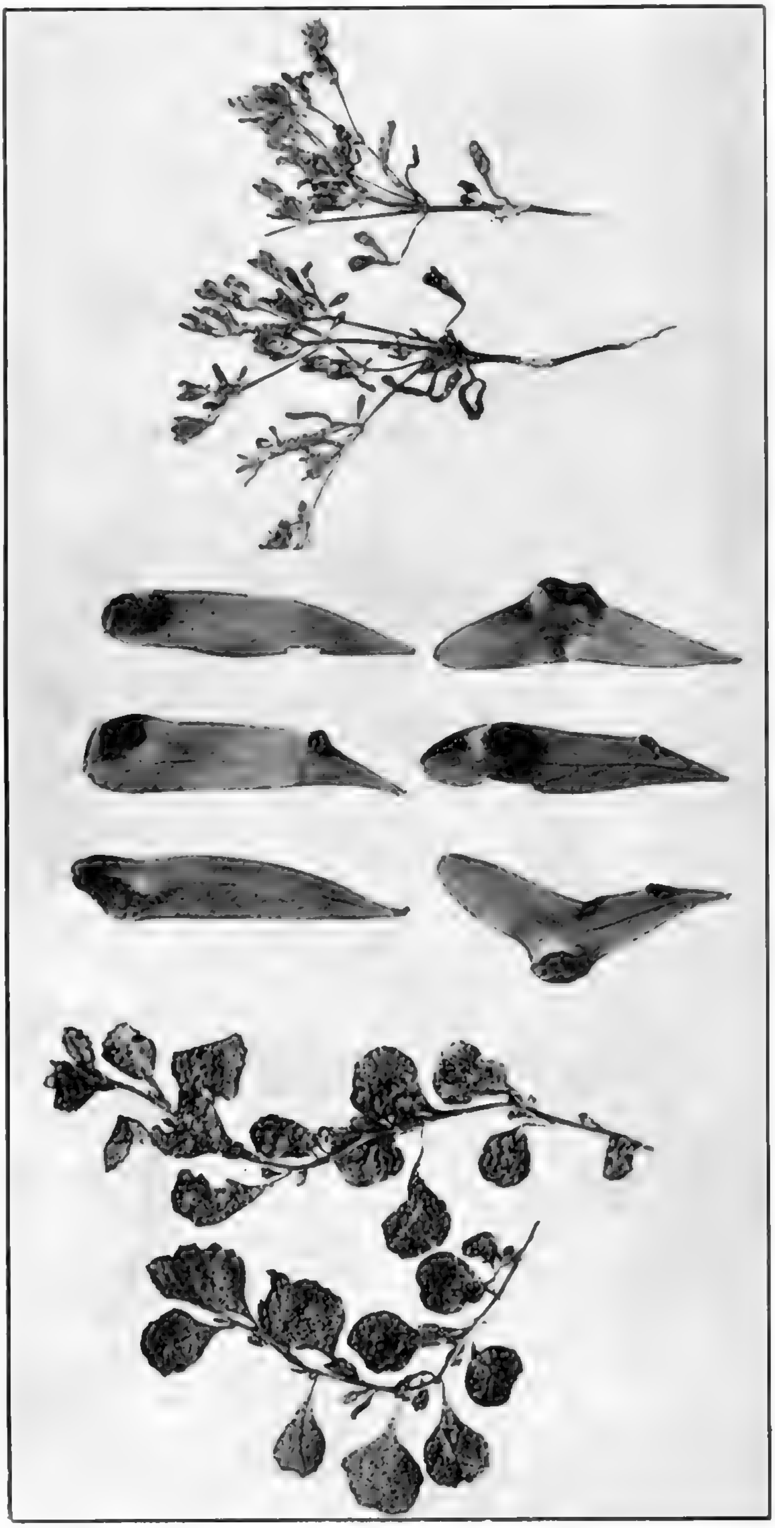

Fig. 3.

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Fig. 3.

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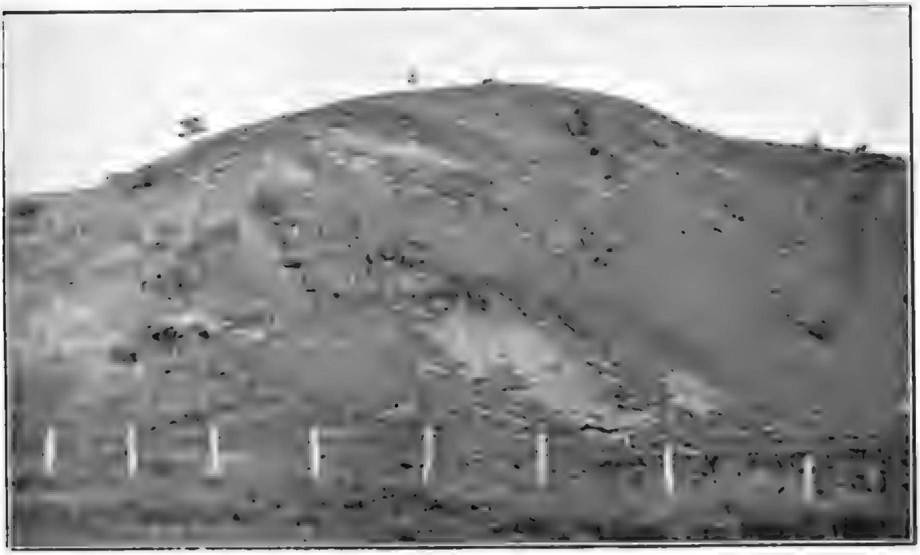

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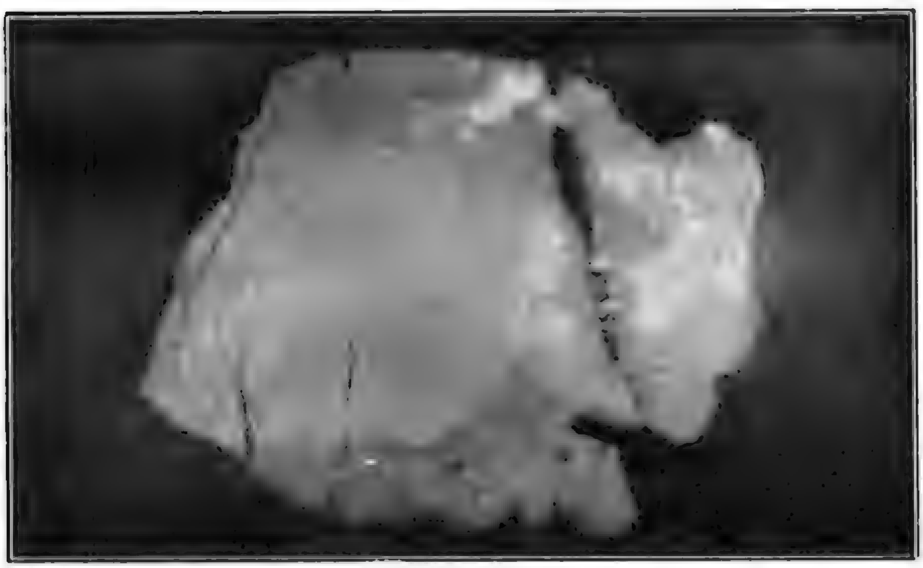

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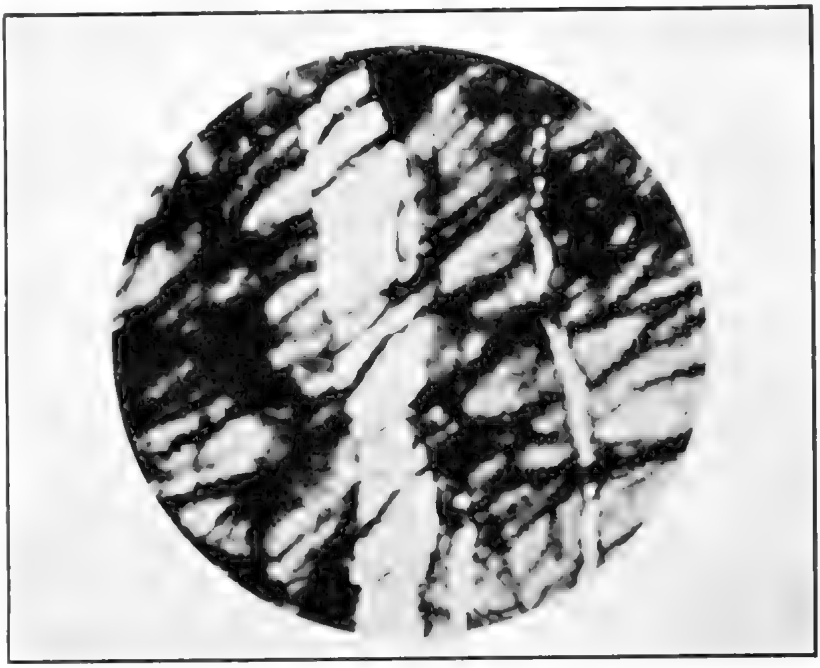

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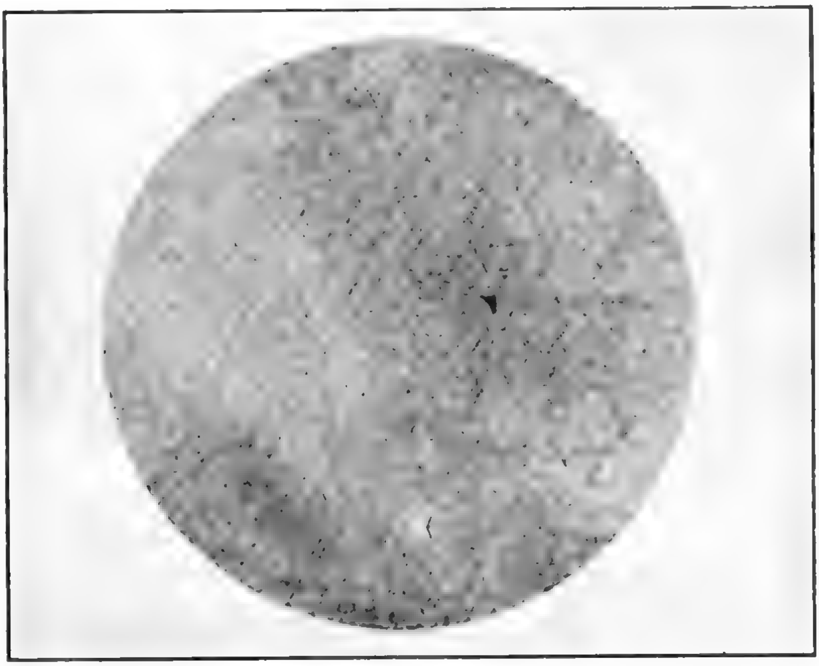

Fig. 2

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Upper part of Tillite capped by 3 feet of Fossiliferous Pliocene.

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Fig. 1

Fig. 2

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Fig. 1.

Fig. 2.

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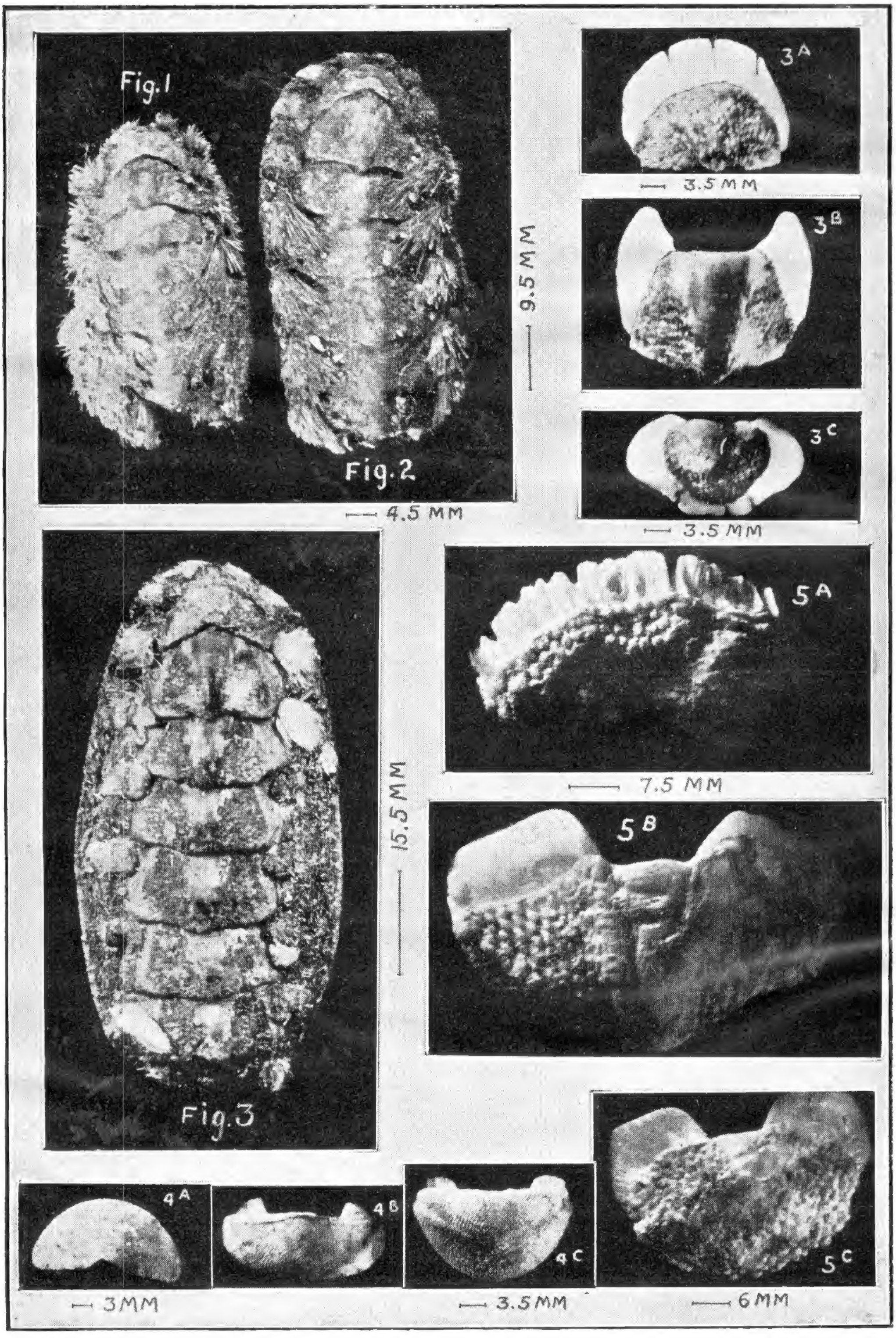

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